*November 1994*

Idaho National Engineering Laboratory

IDAHO DEPARTMENT OF HEALTH AND WELFARE
DIVISION OF ENVIRONMENTAL QUALITY

# Record of Decision

## Declaration for Organic Contamination in the Vadose Zone

## Operable Unit 7-08

### Idaho National Engineering Laboratory
### Radioactive Waste Management Complex
### Subsurface Disposal Area

# DECLARATION OF THE RECORD OF DECISION

## SITE NAME AND LOCATION

**Organic Contamination in the Vadose Zone (OCVZ)**
**Subsurface Disposal Area**
**Radioactive Waste Management Complex**
**Idaho National Engineering Laboratory**
**Idaho Falls, Idaho**

## STATEMENT OF BASIS AND PURPOSE

This decision document presents the selected remedial action for the Organic Contamination in the Vadose Zone (OCVZ) site located at the Idaho National Engineering Laboratory (INEL). The remedial action was chosen in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) as amended by the Superfund Amendments and Reauthorization Act (SARA), and is consistent, to the extent practicable, with the National Oil and Hazardous Substances Pollution Contingency Plan (NCP, 40 CFR Part 300). Information supporting the selection of the remedy is contained in the Administrative Record for the OCVZ Remedial Action.

The lead agency of this decision is the U.S. Department of Energy (DOE). The U.S. Environmental Protection Agency (EPA) approves of this decision and, along with the Idaho Department of Health and Welfare (IDHW), has participated in the evaluation of final action alternatives. The IDHW concurs with the selection of the preferred remedy for the OCVZ.

## ASSESSMENT OF THE SITE

Actual or threatened releases of hazardous substances from this site, if not addressed by implementing the response action selected in this record of decision (ROD), may present an imminent and substantial endangerment to public health, welfare, or the environment. Implementation of the remedial action selected in this ROD will provide extraction of the organic contaminants present in the most significant concentrations in the vadose zone beneath and within the immediate vicinity of the Radioactive Waste Management Complex (RWMC). These extracted contaminants will be destroyed through treatment at the surface of the RWMC. Extraction and destruction of the organic contaminants will prevent the long-term contamination of the Snake River Plain Aquifer (SRPA) above acceptable levels. The selected remedial action is not intended to address potential contaminants such as radionuclides and metals. These contaminants will be investigated as part of a comprehensive remedial investigation and feasibility study scheduled to begin in 1996.

## DESCRIPTION OF THE SELECTED REMEDY

This ROD addresses the OCVZ at the RWMC of the INEL. The RWMC has been designated as Waste Area Group (WAG) 7 of the 10 WAGs currently under investigation at the INEL pursuant to the Federal Facility Agreement and Consent Order (FFA/CO) between the IDHW, the EPA, and the U.S. Department of Energy Idaho Operations Office (DOE-ID). OCVZ, designated as Operable Unit (OU) 7-08, is part of WAG 7.

The vadose zone extends from the ground surface to the top of the SRPA, approximately 580 ft below the surface. The vadose zone contains volatile organic compounds, primarily in the form of organic vapors, which have migrated from organic wastes disposed of in pits at the Subsurface Disposal Area (SDA) of the RWMC. Organic wastes remaining in the pits are not addressed with the selected remedy described in this ROD. Instead, risks to human health and the environment associated with these wastes will be evaluated as part of the remedial investigation and feasibility study which is to begin in 1994 for the disposal pits.

The selected remedy for OCVZ will provide extraction/destruction of organic contaminant vapors present in the vadose zone beneath and within the immediate vicinity of the RWMC. In addition, the selected remedy will include monitoring of vadose zone vapor and the SRPA. The objective of this selected remedy will be to reduce the risks to human health and the environment associated with the organic contaminants present in the vadose zone and to prevent Federal and state safe drinking water standards from being exceeded in the future.

The major components of the selected remedy include:

- The installation and operation of five vapor extraction wells (in addition to an existing vapor extraction well) at the RWMC as part of a first phase effort to extract organic contaminant vapors from the vadose zone. The selected remedy includes options to expand the number of vapor extraction wells for potential second and third phases. Additional system modifications will be evaluated with each phase transition.

- The installation and operation of off-gas treatment systems to destroy the organic contaminants present in the vapor removed by the extraction wells. Off-gas treatment will be in the form of catalytic oxidation or an equally effective organic contaminant destruction technology.

- The addition of soil vapor monitoring wells to monitor the performance of the vapor extraction wells and verify the attainment of remedial action objectives. Soil vapor monitoring will also provide information used to evaluate potential modifications to the selected remedy to continue it beyond the first phase. The expected duration of the first phase is approximately two years; potential second and third phases would operate for approximately two years each. The actual duration of each phase is dependent on elements such as equipment procurement and installation that may be involved with each potential phase transition.

- The maintenance of institutional controls, which includes: using signs, restricting access, maintaining fences/barriers, and monitoring the existing production well supplying water to workers at the RWMC. It is presumed that this level of institutional control will be maintained at the RWMC through the year 2091.

Organic wastes remaining in the pits could extend the timeframe required to achieve remedial action objectives using the selected remedy since the remaining organic wastes could act as a "long-term" source of organic contamination in the vadose zone.

## STATUTORY DETERMINATION

The selected remedy is protective of human health and the environment, complies with Federal and state applicable or relevant and appropriate requirements (ARARs), and is cost-effective. This remedy uses permanent solutions and alternative treatment technologies to the maximum extent practicable for this site. The most concentrated areas of organic contaminants present in the vadose zone will be extracted and destroyed. As such, the selected remedy satisfies the statutory preference for treatment as a principal element of the remedy.

For those remedial actions that allow hazardous substances to remain on-site, Section 121 (c) of CERCLA requires that a review of the remedy be conducted within five years after initiation of the remedial action and at least once every five years thereafter. The purpose of this review is to evaluate the remedy's performance—to ensure that the remedy has achieved, or will achieve, the remedial action objectives set forth in the ROD and that it continues to be protective of human health and the environment. Reviews for the OCVZ selected remedy will be conducted as described below.

The potential progression of the selected remedy to a second and third phase is dependent on the ability of the vapor extraction system to achieve the remedial action objectives, i.e., ensure that risks to future groundwater users are within acceptable guidelines and that future contaminant concentrations in the aquifer remain below Federal and state safe drinking water standards. During implementation of the selected remedy at OCVZ, the remedy's performance will be reviewed on a two year (24 month) cycle, with each phase of operation under the selected remedy expected to last at least two years. The actual duration of each phase is dependent on elements such as equipment procurement and installation that may be involved with each transition. The following description of the review cycle assumes that transitions will occur in a timely fashion every 24 months.

The first review will commence after 18 months of operation under the first phase. Data accumulated over these 18 months will be analyzed and a decision made by DOE, EPA, and the IDHW as to what will comprise the second phase of the selected remedy (if a second phase is necessary to attain remedial action objectives). The selected remedy will continue under first phase operations up to 24 months, at which time, after the data analysis period, a transition to the second phase will occur. Data analyzed will be relevant to the attainment of remedial action objectives (e.g., contaminant recovery rates, equilibrium contaminant concentrations in the vadose zone, etc.).

Considerable engineering judgement will be used in deciding what modifications to the first phase will be made to continue the selected remedy into a second phase in order to achieve remedial action objectives. Potential options for continuing the selected remedy into a second phase include:

(1) continuing operation with no changes to the first phase of operation; (2) adding more vapor extraction wells; (3) extracting from different depths within existing extraction wells; (4) converting monitoring wells into extraction wells; and (5) adding and/or converting existing wells to passive venting wells. These options and others not currently identified may be carried out singly or in combinations, with the intent being to ensure that the selected remedy achieves remedial action objectives.

The need for additional phases beyond a second phase will be evaluated using the same general approach as outlined above for the transition between the first and possible second phase. If a second phase is implemented, then the data evaluation and decision regarding a possible third phase will begin 18 months into the second phase (i.e., 42 months from the start of the selected remedy) with the third phase beginning, if necessary, approximately 48 months from the start of the selected remedy. Potential options for continuing the selected remedy into a third phase would be similar to those listed above. This type of phased operation will continue through phases lasting 24 months each until remedial action objectives are achieved. In addition to the 2 year reviews associated with the potential phases under the selected remedy, a review will be conducted five years after remedial action objectives have been achieved, and extraction/treatment operations have been discontinued.

Signature sheet for the foregoing OCVZ located in the Subsurface Disposal Area of the Radioactive Waste Management Complex at the Idaho National Engineering Laboratory Record of Decision between the U.S. Department of Energy and the Environmental Protection Agency, with concurrence by the Idaho Department of Health and Welfare.

John M. Wilcynski | 11/14/94
Date

John M. Wilcynski
Manager
U.S. Department of Energy, Idaho Operations Office

Signature sheet for the foregoing OCVZ located in the Subsurface Disposal Area of the Radioactive Waste Management Complex at the Idaho National Engineering Laboratory Record of Decision between the U.S. Department of Energy and the Environmental Protection Agency, with concurrence by the Idaho Department of Health and Welfare.

Chuck Clarke DEC 2 1994

Chuck Clarke
Regional Administrator, Region 10
U.S. Environmental Protection Agency

Date

Signature sheet for the foregoing OCVZ located in the Subsurface Disposal Area of the Radioactive Waste Management Complex at the Idaho National Engineering Laboratory Record of Decision between the U.S. Department of Energy and the Environmental Protection Agency, with concurrence by the Idaho Department of Health and Welfare.

David L. Humphrey          11/28/94

for Jerry L. Harris          Date
Director
Idaho Department of Health and Welfare

# CONTENTS

# FIGURES



# TABLES

## ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| ARAR | Applicable or Relevant and Appropriate Requirement |
| AT | Averaging Time |
| BW | Body Weight |
| $CCl_4$ | carbon tetrachloride |
| CERCLA | Comprehensive Environmental Response, Compensation, and Liability Act |
| COC | Contaminant of Concern |
| COCA | Consent Order and Compliance Agreement |
| CFM | cubic feet per minute |
| DOE | Department of Energy |
| DOE-ID | Department of Energy Idaho Operations Office |
| ECU | Environmental Chemistry Unit |
| ED | Exposure Duration |
| EF | Exposure Frequency |
| EPA | Environmental Protection Agency |
| FFA/CO | Federal Facility Agreement and Consent Order |
| FR | Federal Register |
| ft | feet |
| HEAST | Health Effects Assessment Summary Tables |
| IDHW | Idaho Department of Health and Welfare |
| in. | inch |
| INEL | Idaho National Engineering Laboratory |
| IR | Ingestion Rate |
| IRIS | Integrated Risk Information System |

| | |
|---|---|
| kg | kilogram |
| l | liter |
| lbs | pounds |
| m | meter |
| MCL | Maximum Contaminant Level |
| mi | mile |
| min | minute |
| NCP | National Oil and Hazardous Substances Pollution Contingency Plan |
| NPL | National Priorities List |
| OCVZ | Organic Contamination in the Vadose Zone |
| OU | Operable Unit |
| PCE | tetrachloroethylene |
| PRG | preliminary remediation goal |
| PPB | parts per billion |
| PPMV | parts per million volume |
| RAG | Risk Assessment Guidance |
| RCRA | Resource Conservation and Recovery Act |
| RI/FS | Remedial Investigation/Feasibility Study |
| ROD | Record of Decision |
| RR | Respiration Rate |
| RWMC | Radioactive Waste Management Complex |
| SARA | Superfund Amendments and Reauthorization Act |
| SDA | Subsurface Disposal Area |
| SRPA | Snake River Plain Aquifer |

| | |
|---|---|
| TCA | trichloroethane |
| TCE | trichloroethylene |
| TRU | Transuranic |
| TSA | Transuranic Storage Area |
| VOC | volatile organic compound |
| VVE | Vapor Vacuum Extraction |
| WAG | Waste Area Group |
| yr | year |
| μg | microgram |

# Decision Summary

## 1. SITE NAME, LOCATION, AND DESCRIPTION

The Idaho National Engineering Laboratory (INEL) is a government facility managed by the U.S. Department of Energy (DOE) located 32 miles (mi) west of Idaho Falls, Idaho, and occupies 890 $mi^2$ of the northeastern portion of the Eastern Snake River Plain. The Radioactive Waste Management Complex (RWMC) is located in the southwestern portion of the INEL (Figure 1). The majority of the organic contamination associated with the Organic Contamination in the Vadose Zone (OCVZ) operable unit (OU) is within the subsurface of the area outlined in Figure 1, and the highest contaminant concentrations are found immediately beneath the Subsurface Disposal Area (SDA), an area with several disposal pits and trenches previously used for the disposal of organic wastes. The SDA is a 88-acre area located within the RWMC. The RWMC encompasses 144 acres (approximately 0.23 $mi^2$) and consists of both the SDA and the Transuranic (TRU) Storage Area.

Current land use at the INEL is primarily nuclear research and development and waste management. Surrounding areas are managed by the Bureau of Land Management for multipurpose use. The developed area within the INEL is surrounded by a 500 $mi^2$ buffer zone used for cattle and sheep grazing.

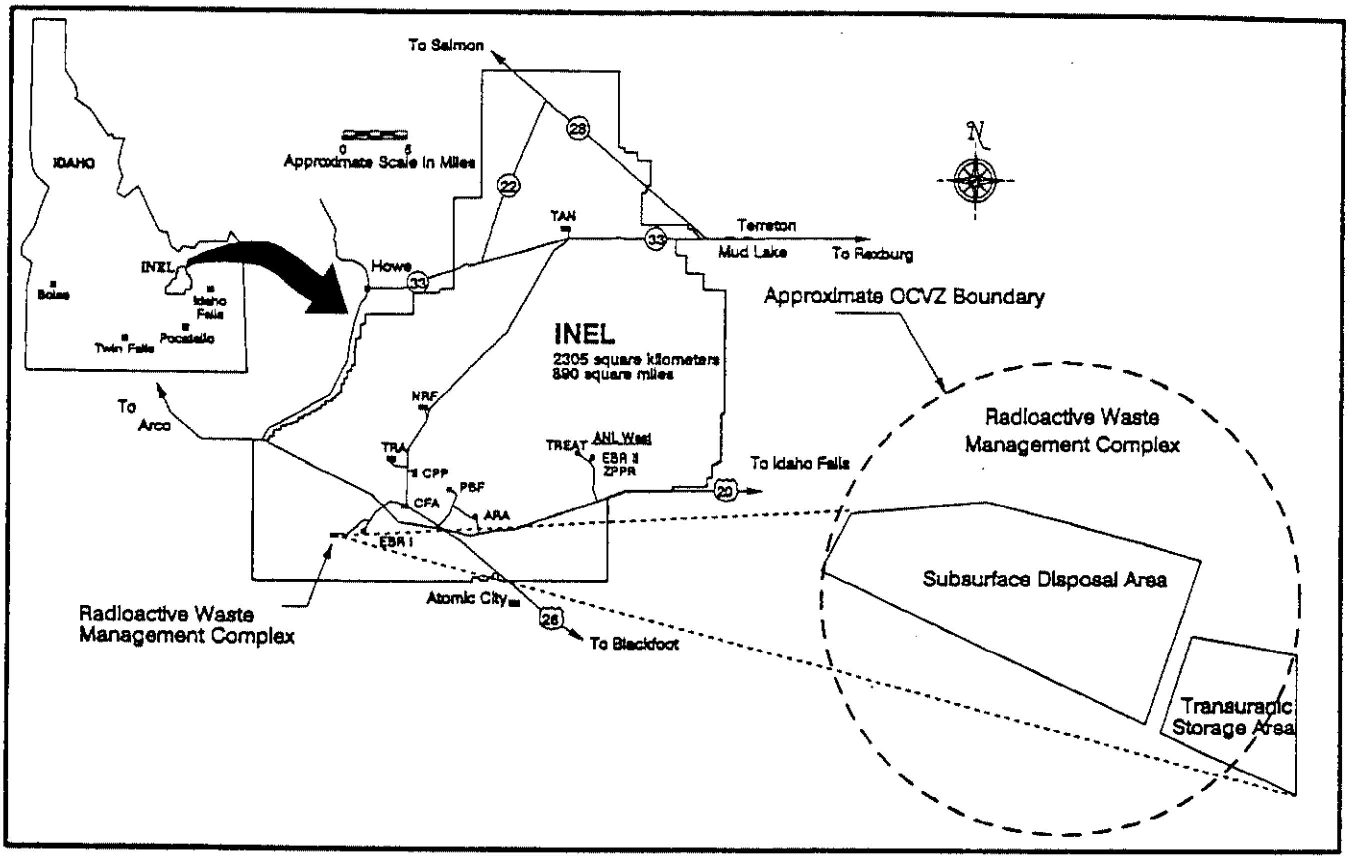


**Figure 1.** The Radioactive Waste Management Complex at the INEL.

Of the 11,700 people employed at the INEL, approximately 100 are located at the RWMC. The nearest off-site populations are in Atomic City (12 mi southeast of RWMC), Arco (16 mi northwest of RWMC), Howe (19 mi north of RWMC), Mud Lake (36 mi northeast of RWMC), and Terreton (37 mi northeast of RWMC).

The INEL property is located on the northeastern edge of the Eastern Snake River Plain, a volcanic plateau that is primarily composed of volcanic rocks and relatively minor amounts of sedimentary interbeds. The basalts immediately beneath the RWMC are relatively flat and covered by 20 to 30 feet (ft) of alluvium.

The depth to the Snake River Plain Aquifer (SRPA) underlying the INEL varies from 200 ft in the northern portion to 900 ft in the southern portion. The depth to the SRPA at the RWMC is about 580 ft. Flow of the aquifer in this region is generally to the south-southwest. Organic contaminants beneath the RWMC are currently migrating toward the aquifer. Some contaminants have already reached the aquifer, but they are at concentrations that are below Federal and state safe drinking water standards [i.e., Maximum Contaminant Levels (MCLs)]. Contaminants that reach the aquifer are carried by the flow of the groundwater in the southwest direction, potentially beyond the southern boundary of the INEL.

The INEL has semi-desert characteristics with hot summers and cold winters. Normal annual precipitation is 9.1 inches per year (in/yr), with estimated evapotranspiration of 6 to 9 in/yr. The only surface water present in the southern portion of the INEL is the Big Lost River, which is approximately 1.5 mi northwest of the RWMC; however, due to irrigation diversions upstream, this river is typically dry. Surface water is present at the RWMC only during and following periods of heavy rainfall and snowmelt, which generally occur in January through April.

To minimize the potential for surface water to flow onto the RWMC during periods of high surface water runoff at the INEL, water is diverted from the RWMC via spreading areas and associated dikes, located to the west and south of the RWMC. To further enhance surface water diversion from disposal pits and trenches, berms have also been constructed immediately around the SDA.

Twenty distinctive vegetative cover types have been identified at the INEL. Big sagebrush is the dominant species, covering approximately 80 percent of the ground surface. The variety of habitats on the INEL support numerous species of reptiles, birds, and mammals. Several bird species at the INEL that warrant special concern because of sensitivity to disturbance or their threatened status include the ferruginous hawk (*Buteo regalis*), bald eagle (*Haliaeetus leucocephalus*), long-billed curlew (*Numenius americanus*), and the loggerhead shrike (*Lanius Ludovicianus*). In addition, the Townsend's big-eared bat (*Plecotus Townsendii*) and pygmy rabbit (*Brachylagus Idahoensis*) are listed by the U.S. Fish and Wildlife Service as candidate species for consideration as threatened or endangered species. The ringneck snake, whose occurrence is considered to be INEL-wide, is listed by the Idaho Department of Fish and Game as a Category C sensitive species.

The OCVZ operable unit is defined as that part of the vadose zone beneath and within the immediate vicinity of the RWMC where there are organic contaminants in the vapor state. Their presence is a result of the burial at the SDA disposal pits of organic wastes from the Rocky Flats Plant in Colorado. OCVZ does not include the wastes remaining in the disposal pits (i.e., contaminated solids, drums, etc.). It only includes those organic compounds that have migrated from the wastes. The organic compounds are primarily carbon tetrachloride, 1,1,1-trichloroethane, trichloroethylene, and tetrachloroethylene.

## 2. SITE HISTORY AND ENFORCEMENT ACTIVITIES

The RWMC was established in the early 1950s as a disposal site for solid, low level waste generated by INEL operations. Within the RWMC is the SDA, where hazardous substances, including radioactive wastes and organic wastes, have been disposed of in underground pits, trenches, soil vault rows, and Pad A—an aboveground pad. TRU waste was disposed of in the SDA from 1952 to 1970 and was received from the Rocky Flats Plant for disposal in the SDA from 1954 to 1970. The Rocky Flats Plant is a DOE-owned facility located west of Denver, Colorado. The Rocky Flats Plant is used primarily for the production of plutonium components for nuclear weapons. Also located at the RWMC is the Transuranic Storage Area (TSA), where interim storage of TRU waste occurs in containers on asphalt pads. The TSA accepted TRU waste from off-site generators for storage from 1970 through 1988. TRU waste generated at the INEL is still stored at the TSA.

Organic contaminants that are part of the OCVZ operable unit are present in the subsurface fractured basalt and sedimentary interbeds (i.e., the vadose zone) beneath and within the immediate vicinity of the RWMC, above the SRPA. The presence of organic contaminants in the vadose zone is a result of the burial, and breach, at the SDA of containerized organic wastes from the Rocky Flats Plant. From 1966 to 1970, approximately 88,400 gallons of organic wastes were mixed with calcium silicate to reduce free liquids and form a grease- or paste-like material prior to being placed in containers and sent to the INEL for disposal in several pits at the SDA. Pits 4, 5, 6, 9, and 10 have been identified as receiving the organic wastes. Also, Pit 2 received an unknown quantity of organic waste before 1966, and the acid pit may have received organic wastes during past operations. The locations of these pits are shown in Figure 2. Section 11 of this record of decision (ROD) provides additional information on the waste inventory at the disposal pits of the SDA.

A Consent Order and Compliance Agreement (COCA) was entered into between DOE and the U.S. Environmental Protection Agency (EPA) pursuant to the Resource Conservation and Recovery Act (RCRA) Section 3008(h) in August 1987. The COCA required DOE to conduct an initial assessment and screening of all solid waste and/or hazardous waste disposal units at the INEL, and set up a process for conducting any necessary corrective actions.

On July 14, 1989, the INEL was proposed for listing on the National Priorities List (NPL) [54 Federal Register (FR) 29820]. The listing was proposed by the EPA under the authorities granted EPA by the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA). The INEL was listed on the NPL on November 21, 1989 (54 FR 44184).

As a result of the INEL's listing on the NPL in November 1989, DOE, EPA, and the Idaho Department of Health and Welfare (IDHW) entered into a Federal Facility Agreement and Consent Order (FFA/CO) on December 9, 1991. Under the FFA/CO, OCVZ was identified for a Remedial Investigation/Feasibility Study (RI/FS). This ROD documents the results of the RI/FS and the remedy selected. The entire RWMC will be evaluated in the Waste Area Group (WAG) 7 Comprehensive RI/FS which is scheduled to begin no later than July 1996.

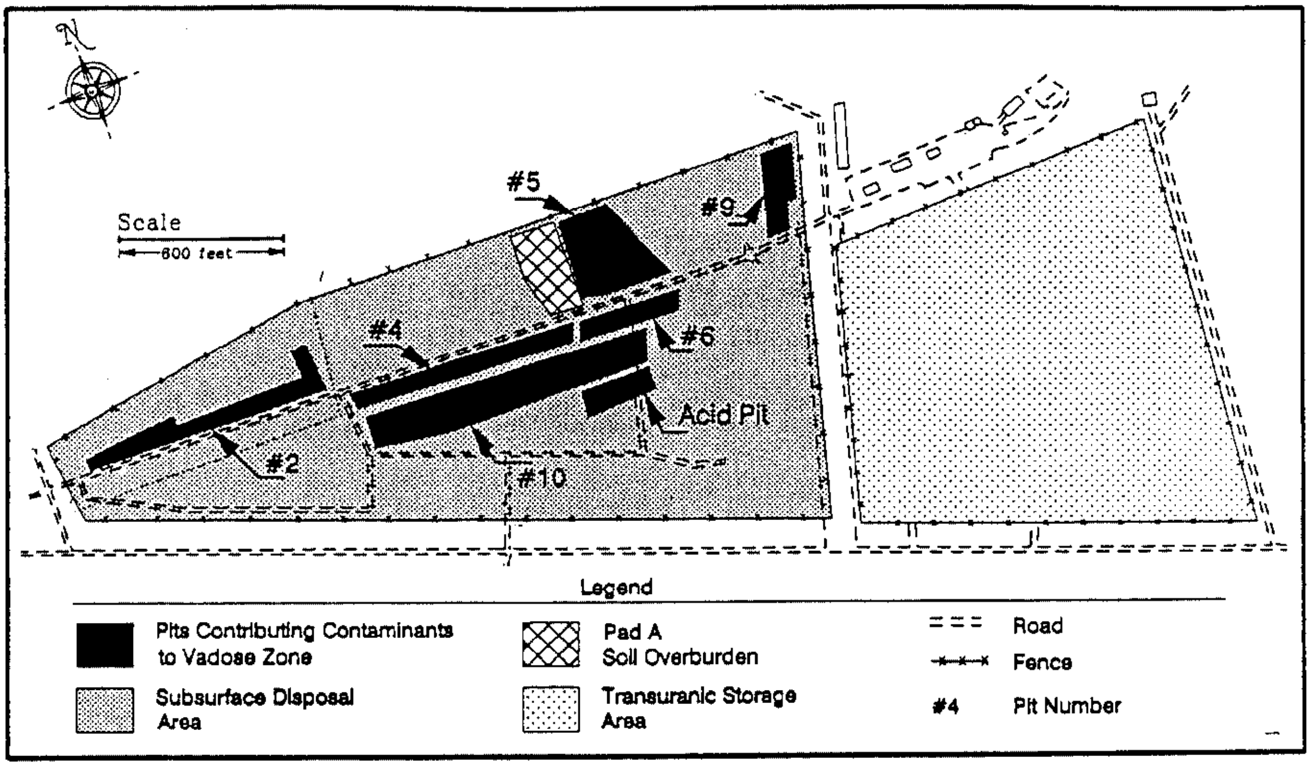


**Figure 2.** The RWMC with pits contributing organic contamination to the vadose zone.

# 3. HIGHLIGHTS OF COMMUNITY PARTICIPATION

In accordance with CERCLA § 113(k)(2)(B)(i-v) and 117, a series of opportunities for public information and participation in the remedial investigation and decision process for OCVZ were provided over the course of 29 months beginning in November 1991 and continuing through April 1994. For the public, the activities ranged from receiving a fact sheet that briefly discussed the OCVZ investigation to date, *INEL Reporter* articles and updates, and a proposed plan, to having a telephone briefing, four public scoping meetings, three public meetings, and two open houses to offer verbal or written comments during two separate 30-day public comment periods.

On November 19, 1991, a fact sheet concerning OCVZ was conveyed through a "Dear Citizen" letter to a mailing list of 5,600 individuals of the general public and 11,700 INEL employees in advance of the public scoping meetings scheduled on December 9, 10, 11, and 12, 1991. On November 20, the DOE issued a news release to more than 40 news media contacts concerning the beginning of a 30-day public scoping comment period, which ended January 3, 1992, on the OCVZ remedial investigation. Both the letter and release gave notice to the public that OCVZ documents would be available before the beginning of the comment period in the Administrative Record section of the INEL Information Repositories located in the INEL Technical Library of Idaho Falls, as well as in city libraries in Idaho Falls, Pocatello, Twin Falls, Boise, and Moscow. Display ads announcing the same information appeared in eight major Idaho newspapers. Large ads appeared in the following newspapers from November 22 to the 27: *Post Register* (Idaho Falls); *Idaho Sate Journal* (Pocatello); *South Idaho Press* (Burley); *Times News* (Twin Falls); *Idaho Statesman* (Boise); *Idaho Press Tribune* (Nampa); *Lewiston Morning Tribune* (Lewiston); and *Idahonian* (Moscow).

Similar display ads concerning upcoming meetings appeared in seven of these newspapers several days preceding each local meeting to encourage citizens to attend and provide verbal or written comments. All three media—the Dear Citizen letter, news release, and newspaper ads—gave public notice of four scoping meetings concerning the beginning of the investigation of OCVZ and the beginning of a 30-day public comment period that was to begin December 4, 1991. Additionally, two radio stations in Idaho Falls and newspapers in Idaho Falls and other communities repeated announcements from the news release to the public at large. A total of seven radio advertisements were made by local stations where meetings were scheduled several days before and the day of the meetings.

Personal phone calls concerning the availability of OCVZ documents and public meetings were made to individuals, environmental groups and organizations by INEL Outreach Office staff in Pocatello, Twin Falls, and Boise. The Community Relations Plan Coordinator made calls in Idaho Falls and Moscow.

Scoping meetings on OCVZ were held December 9, 10, 11, 12, 1991 in Boise, Moscow, Twin Falls, and Idaho Falls, respectively. An informal open house was held one hour prior to each of the meetings to allow the public to visit with State and Federal representatives about OCVZ. During these meetings, representatives from DOE and INEL discussed the project, answered both written and verbal questions, and received public comments. Written comment forms were distributed at the meetings. Comments from the scoping meetings were evaluated and considered as part of the RI/FS process.

Regular reports concerning the status of the OCVZ project were included in the *INEL Reporter* and mailed to those who attended the meetings and who were on the mailing list. Reports appeared in the March, May, July, and November 1992; and the January, March, and July 1993 issues of the *INEL Reporter*. During this time the number of individuals on the mailing list increased to 7,000. Individuals on the mailing list, those who attended the meetings, and all INEL employees received issues of the *INEL Reporter*.

Opportunities for public involvement in the decision process for OCVZ were provided beginning in March 1994. For the public, the activities ranged from receiving the proposed plan, conducting one teleconference call, and attending open houses and public meetings to informally discuss issues and offer verbal and written comments to the agencies during the 30-day public comment period.

On March 18, 1994, the Department of Energy Idaho Operations Office (DOE-ID) issued a news release to more than 40 news media contacts concerning the beginning of a 30-day public comment period on the OCVZ proposed plan. The release also gave notice to the public that OCVZ documents would be available before the beginning of the comment period in the Administrative Record section of the INEL Information Repositories located in the INEL Technical Library in Idaho Falls, the Shoshone-Bannock Library at Fort Hall, the University of Idaho Library in Moscow, the Idaho State Library in Boise; as well as city libraries in Idaho Falls, Pocatello, Twin Falls, Boise, and Moscow.

Copies of the proposed plan for OCVZ were mailed to 7,000 members of the public and 400 INEL employees on the INEL Community Relations Plan mailing list on March 28, 1994 urging citizens to comment on the plan and to attend public meetings. Display ads announcing the same information and the location of open houses in Pocatello and Twin Falls, and public meetings in Idaho Falls, Boise, and Moscow appeared in seven major Idaho newspapers. Large ads appeared in the following newspapers from March 15 to 20: *Post Register* (Idaho Falls), *Idaho State Journal* (Pocatello), *South Idaho Press* (Burley), *Times News* (Twin Falls), *Idaho Statesman* (Boise), *Lewiston Morning Tribune* (Lewiston), and *The Daily News* (Moscow).

Similar display ads concerning upcoming meetings appeared in each of these newspapers several days preceding each local open house or meeting to encourage citizens to attend and provide verbal or written comments. Both media, the news release and newspaper adds, gave public notice of public involvement activities and offerings for briefings, and the beginning of a 30-day public comment period that was to begin March 31 and run through April 30, 1994. Additionally, radio stations in Idaho Falls, Blackfoot, Pocatello, Burley, and Twin Falls ran advertisements during the three days prior to the open houses in Pocatello and Twin Falls.

The open houses were held in Pocatello and Twin Falls on April 12 and April 14, respectively, and the public meetings were held in Idaho Falls, Boise, and Moscow on April 18, 20, and 21, 1993, respectively. Written comment forms, including a postage-paid business reply form, were made available to those attending the meetings. The forms were used to turn in written comments at the meeting, and by some, to mail in comments later. The reverse side of the meeting agenda contained a form for the public to evaluate the effectiveness of the meetings. A court reporter was present at each meeting to keep a verbatim transcript of discussions and public comments. The meeting transcripts were placed in the Administrative Record section for OCVZ, OU 7-08, in eight INEL Information Repositories.

On April 13, 1994, a teleconference call between the League of Woman Voters of Moscow and the Environmental Defense Institute, DOE-ID, EPA, and the IDHW concerning INEL environmental restoration issues was conducted at the request of Moscow area residents. The call consisted of an overview of the proposed plan, questions and answers, and general discussion of OCVZ issues.

Personal phone calls concerning the availability of the proposed plan and the public meetings were made to individuals, environmental groups, and organizations by INEL Community Relations Plan staff in Idaho Falls and Boise. Outreach Office staff made calls to citizens in northern, southwestern, and southeastern Idaho.

Another series of ads were placed in the same local papers several days before the public meetings to encourage citizens to attend and comment on the plan. Additionally, a special feature article in the July issue of the *INEL Reporter* was mailed to individuals on the INEL Community Relations Plan mailing list as a reminder of the meetings and the opportunity to comment on the proposed plan.

A Responsiveness Summary has been prepared as part of the ROD. All formal verbal comments, as given at the public meetings, and all written comments, as submitted, are repeated verbatim in the Administrative Record for the ROD. Those comments are annotated to indicate which response in the Responsiveness Summary addresses each comment.

A total of about 83 people attended the OCVZ public meetings. Overall, 27 provided formal comments; of these 27 people, 12 people provided oral comments and 15 people provided written comments. DOE further divided the oral and written comments into 91 separate comments. All comments received on the proposed plan were considered during the development of this ROD. The decision for this action is based on the information in the Administrative Record for this OU.

# 4. SCOPE AND ROLE OF OPERABLE UNIT AND RESPONSE ACTION

Under the FFA/CO, the INEL is divided into 10 WAGs. The WAGs are further divided into OUs. The RWMC has been designated WAG 7 and consists of 14 OUs. Data from shipping records, along with process knowledge, written correspondence, and existing monitoring data, were available to allow OCVZ, OU 7-08, to be evaluated in an expeditious manner. OCVZ consists of the organic contaminants present in the vadose zone beneath and within the immediate vicinity of the RWMC, but does not include the waste materials disposed of in the pits of the SDA. Potentially, organic wastes remaining in the pits could impact alternatives considered for remediation of the vadose zone. However, given the current level of information available on the organic wastes present within the pits, it is impossible to predict with any certainty whether these wastes will impact remediation at all.

A complete evaluation of all cumulative risks associated with CERCLA actions at WAG 7 will be conducted as part of the WAG 7 Comprehensive RI/FS (OU 7-14) to ensure all risks have been adequately evaluated. Conducting a remedial action at OCVZ is part of the overall WAG strategy and is expected to be consistent with any planned future actions.

# 5. SUMMARY OF SITE CHARACTERISTICS

The following sections provide a summary of the physical characteristics of the site as well as a summary of the contaminants present in various media at the site. Much information on the characteristics of the vadose zone (including contaminant behavior in the vadose zone) was obtained during a treatability study using vapor vacuum extraction (VVE); therefore, a summary of the treatability study is included as Section 5.3.

## 5.1 Geology and Hydrology

The INEL is located along the northern edge of the Eastern Snake River Plain, a 50- to 70-mi wide northeastern trending geologic basin extending from the vicinity of Twin Falls on the southwest part of the plain to the Yellowstone Plateau on the northeast. The Eastern Snake River Plain is underlain by a substantial volume of volcanic rocks with relatively minor amounts of sediment, except along its margins where drainages emerge from the nearby mountain ranges.

The RWMC is underlain by a thick sequence of basaltic lava flows interbedded with thin layers of sediments termed "interbeds." A layer of surficial sediments ranging from 0 to 22 ft thick directly underlies the RWMC. It is within these sediments that the organic wastes were buried at the RWMC. The basalts range from highly fractured and vesicular along the margins of the flows to more dense and less fractured in the interior portions of the flows. The interbeds consist of silt, sand, clay, and fine gravel and are generally less permeable than the fractured basalt.

The RWMC is located in the Pioneer Basin, a topographically closed basin which includes most of the INEL. The Pioneer Basin receives intermittent surface water flow from three drainages that flow onto the INEL from the northwest: The Big Lost River, Little Lost River, and Birch Creek. These drainages usually only flow onto the INEL following wet winters. Precipitation at the INEL averages only 9.1 in (approximately 23 centimeters) per year, but the mountain ranges in the upper reaches of The Big Lost and Little Lost River Basins to the north and west of INEL receive up to 50 in (approximately 125 centimeters) of precipitation per year. Annual average infiltration rates at the RWMC are on the order of a few centimeters per year.

During periods of high runoff in the Big Lost River, water is diverted from the river to spreading basins located to the west of the RWMC. Except for a few hours in the Spring of 1993, water has not been diverted to the spreading areas since 1985. The SDA has flooded three times (1962, 1969, and 1982) prior to completion of the extensive dike system surrounding the SDA. Flooding was a result of local runoff from rain or rapidly melting snow in the spring. Because the SDA is located in a basin, water entered the SDA on each occasion and flooded some pits and trenches. Each of these flooding events may have resulted in recharge to perched water zones and to the SRPA.

The SRPA is present beneath the RWMC at a depth of about 580 ft and, as in the vadose zone, consists of a series of basalt flows with interbedded sedimentary deposits. The EPA designated the SRPA a sole source aquifer under the Safe Drinking Water Act on October 7, 1991 (194 FR 50634). The aquifer is relatively permeable due to the presence of fractures, fissures, and voids such as lava tubes within the basalt. Groundwater flow in the SRPA is to the south-southwest at rates on the order of 5 to 20 ft/day. Infiltration of surface water from the spreading basins to the aquifer has in the past temporarily changed the local gradient beneath the SRPA to the east.

Perched water has been detected in 7 of 45 groundwater monitoring wells drilled at the RWMC. Perched water occurs where infiltrating water accumulates above relatively less permeable zones in the subsurface such as the sedimentary interbeds. Limited zones of perched water have been identified above interbeds located at both 110 and 240 ft. The perched water bodies appear to be laterally discontinuous and are generally only a few feet thick. As such, they are not a viable source of water in the site area.

## 5.2 Nature and Extent of Contamination

The presence of organic contaminants in the vadose zone is a result of the burial, and presumed breach, at the SDA of containerized organic wastes from the Rocky Flats Plant in Colorado. According to Kudera (*Estimate of Rocky Flats Plant Organic Wastes Shipped to the RWMC*, internal note, EG&G Idaho, Inc., July 24, 1987), from 1966 to 1970, approximately 88,400 gallons of containerized organic wastes were disposed of in the SDA. The organic wastes were mixed with calcium silicate to reduce free liquids and form a grease- or paste-like material which was usually double-bagged and placed in drums prior to disposal in several pits at the SDA. In addition, small amounts of absorbent, such as Oil-Dri, were normally mixed with the waste to bind free liquids. The organic wastes consisted of lathe coolant (Texaco Regal Oil and carbon tetrachloride), used oils, and degreasing agents (i.e., chlorinated hydrocarbons) such as 1,1,1-trichloroethane, tricholoethylene, and tetrachloroethylene. Hereinafter, carbon tetrachloride, 1,1,1-trichloroethane, trichloroethylene, and tetrachloroethylene will be referred to using their common abbreviations of $CCl_4$, 1,1,1-TCA, TCE, and PCE, respectively. Specific components of the organic wastes were estimated by Kudera to include 24,000 gallons of $CCl_4$ and 25,000 gallons of other chlorinated hydrocarbons. The balance of the 88,400 gallons was primarily Texaco Regal Oil. Pits 2, 4, 5, 6, 9, and 10 have been identified as receiving the organic wastes, and the acid pit may have received organic wastes. These pits, shown in Figure 2, are suspected of being the source of organic contamination in the vadose zone. Section 11 of this record of decision (ROD) provides additional information on the waste inventory at the disposal pits of the SDA.

$CCl_4$, 1,1,1-TCA, and PCE are considered spent solvents, meeting the definition under IDAPA § 16.01.050.05 (40 CFR 261.31). However, the spent solvents were disposed of in the pits at INEL prior to the promulgation of the RCRA regulations in 1980. The RCRA regulations are relevant and appropriate to these spent solvent wastes according to the criteria of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) regulations.

Sampling conducted for the remedial investigation (RI) has documented that volatile organic compounds (VOCs) have migrated from the disposal pits into the vadose zone. In the vadose zone, VOCs are migrating both vertically (primarily downward) and laterally away from the disposal pits. Vertical migration of contaminants occurs both by vapor diffusion and infiltration of moisture through the vadose zone. Lateral migration occurs primarily by diffusion of VOC vapors. VOCs have been detected in soil vapor, surficial soils, perched water, and in the SRPA. The occurrence of VOCs in each of these media is discussed in the following paragraphs.

**Shallow Soil Vapor**

VOC concentrations in shallow soil vapor were evaluated through soil-gas surveys and gas chromatography conducted in 1987 and 1992. Soil vapor samples were collected through a vapor probe driven 30 in into surficial soil. In general, both surveys yielded the highest VOC concentrations in the vicinity of the pits known to contain organic waste. Of the VOCs analyzed, $CCl_4$ concentrations were highest in both surveys. The results of the 1992 shallow soil-gas survey are plotted for $CCl_4$ on Figure 3. Elevated concentrations of $CCl_4$ were detected above several of the pits including Pits 2, 4, 6, 9, and 10. These results document that VOCs have migrated in the vapor phase from the source pits into shallow soils at the SDA.

The rate at which VOC vapors are being emitted from the shallow soils to the atmosphere was measured using a surface flux chamber at 12 locations at the SDA. Detectable concentrations of one or more VOCs were measured by gas chromatography at 11 of the 12 flux chamber test locations. $CCl_4$ was the target compound measured most frequently and at the highest concentrations. The highest calculated emission rate, 38 micrograms per square meter per minute ($\mu g/m^2/min$), occurred at a location near Pit 6. TCE and chloroform were the compounds with the next highest emission rates (up to 6.6 and 4.3 $\mu g/m^2/min$, respectively). Although there are no records indicating chloroform was one of the organic wastes placed in the disposal pits, its presence was confirmed during field investigations. Clarification on the presence of chloroform can be found in this ROD in Section 6.1.1, Identification of Contaminants of Concern. Acetone and PCE had calculated emission rates up to 3.7 and 3.1 $\mu g/m^2/min$, respectively, while none of the other compounds had emission rates above 2 $\mu g/m^2/min$.

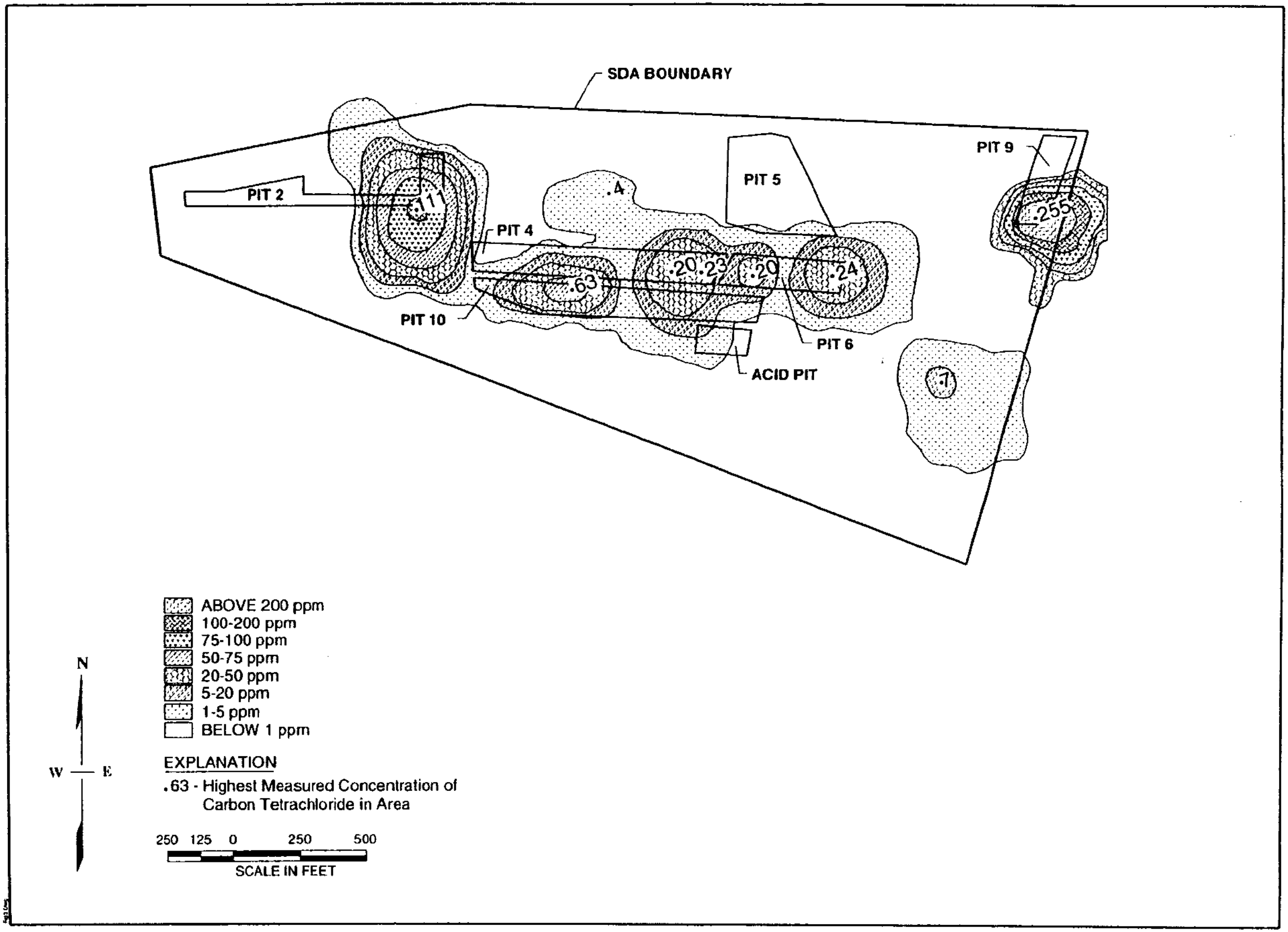


**Figure 3.** $CCl_4$ concentrations in shallow soil vapor at the SDA (1992).

### Shallow Soils

Shallow borings drilled in 1990 around the perimeter of Pit 9 and the Acid Pit were sampled from depths ranging from 0-2 ft to 23 ft. Over 40 samples were analyzed for VOCs. Sampling results indicated that with a few exceptions, all of the positively identified VOC concentrations were at depths of 8 to 23 ft, indicating that VOCs are generally present in the lower portions of the surficial sediments. None of the VOC concentrations exceeded 40 micrograms/kilogram ($\mu$g/kg) and all reported concentrations were well below risk-based screening levels.

### Vadose Zone Vapor

A total of 19 vapor port monitoring wells were used to evaluate the extent and concentration of VOC vapors in the vadose zone. These wells are shown on Figure 4. Samples were collected between July 1992 and March 1993 and analyzed at the Site by a portable Sentex Scentograph Gas Chromatograph Unit. The Sentex was calibrated to detect three VOCs: $CCl_4$, TCE, and chloroform. Approximately 10% of the samples collected between July and September 1992 were submitted to the Environmental Chemistry Unit (ECU) laboratory at the Central Facilities Area for analysis of a more complete suite of organic compounds using a modified EPA TO-14 method. These results are summarized in Table 1.

The ECU data provide a means of comparing $CCl_4$ concentrations with concentrations of less prevalent VOCs. $CCl_4$ concentrations are generally one order of magnitude higher than TCE, chloroform, and 1,1,1-TCA concentrations. Concentrations of PCE, toluene, 1,1,2-trichloro-1,2,2-triflouroethane, and acetone are generally two orders of magnitude less than $CCl_4$ concentrations. These data indicate that $CCl_4$ is the VOC with the highest concentrations in vadose zone vapor. $CCl_4$ concentrations are highest in vapor port monitoring wells located inside the SDA (8801, 8902, and D02), which are located in the central portion of the SDA around Pits 4, 5, 6, and 10.

Mean $CCl_4$ data from 1992 samples are plotted on cross section A-A' (Figure 5). Cross section A-A' is identified on Figure 4. The cross section illustrates that concentrations decrease laterally from the area beneath the source pits and decrease substantially with depth below the 240-foot interbed. The 240-foot interbed appears to provide a layer which impedes or delays downward vapor migration, based on VOC concentration in the deeper vapor port monitoring wells located outside the SDA. The 110-foot interbed also appears to provide a barrier, especially in the central portion of the SDA such as at Well 8801. In this area where higher VOC concentrations are present, concentrations decrease significantly below the 110-foot interbed. No vapor ports have been completed below the 240-foot interbed within the SDA so it is not possible to evaluate the VOC concentrations below the 240-foot interbed directly beneath the source pits.

Data from the new vapor port monitoring wells indicate that $CCl_4$ has migrated in the vapor phase laterally as far as 3,000 ft beyond the SDA boundary. However, $CCl_4$ concentrations in wells located greater than 500 to 1,000 ft from the SDA boundary are three to four orders of magnitude less than concentrations in the immediate source areas.

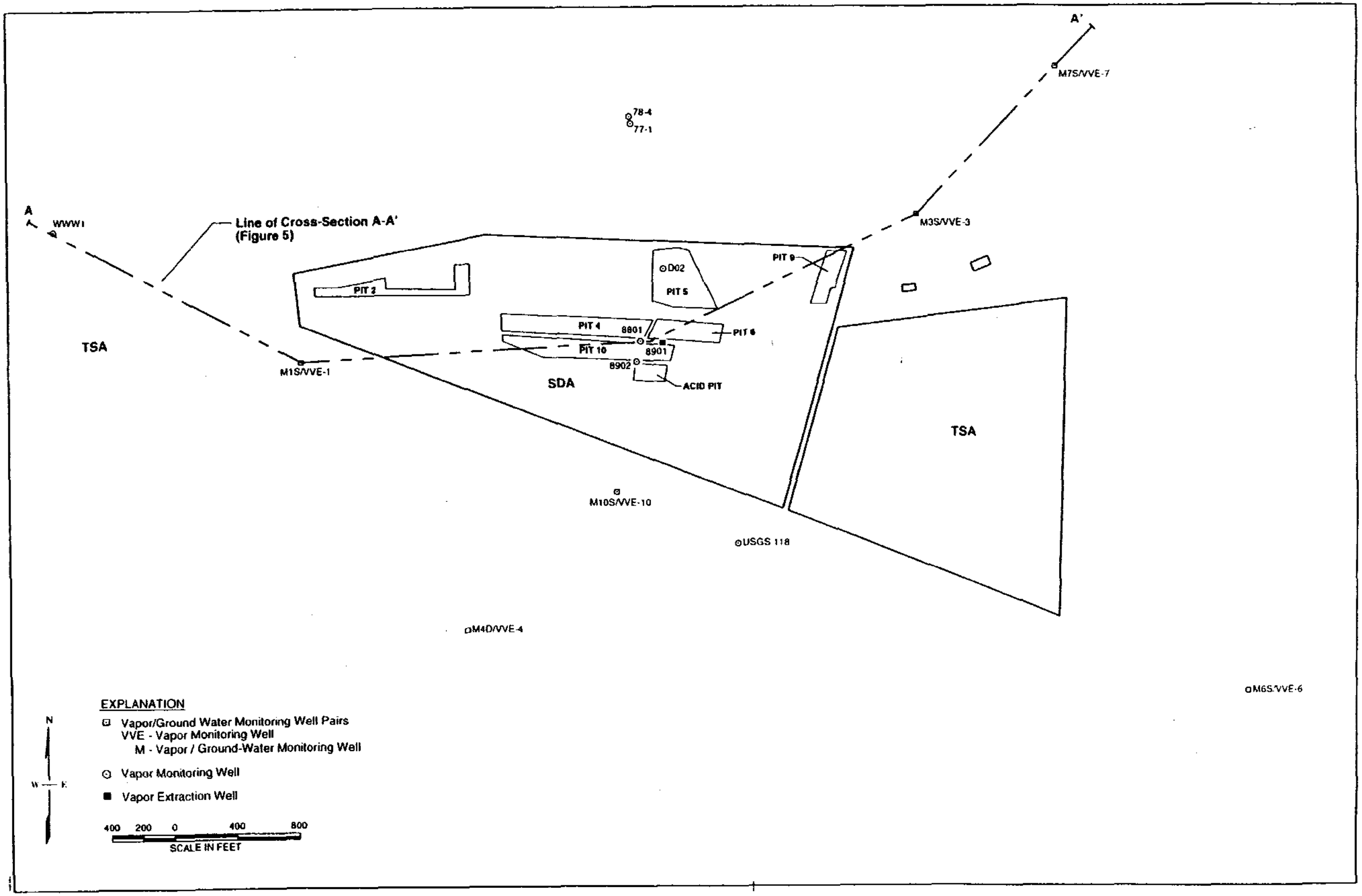


**Figure 4.** Vapor monitoring well locations at the RWMC.

**Table 1.** VOC concentrations in monitoring well vapor ports (ECU data).

| | VVE-1 | | VVE-3 | | VVE-4 | | VVE-6 | VVE-7 | | VVE-10 | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Compound⇓ Port⇒ | P1 | P2 | P2 | P3 | P2 | P3 | P3 | P2 | P3 | P2 | P3 |
| Depth (ft)⇒ | 189 | 127 | 155 | 92 | 145 | 75 | 108 | 133 | 77 | 138 | 75 |
| $CCl_4$ | 23 | 32 | 23 | 16 | 11 | 14 | 1.8 | 0.84 J | 2.0 | 12 | 26 |
| Chloroform | 1.4 | 2.1 | 1.9 | 1.5 | 1.2 | 1.8 | 0.16 J | .080 J | 0.13 J | 0.63 J | 4.0 |
| PCE | 0.67 J | 1.0 | 0.55 J | 0.45 J | 0.39 J | 0.39 J | <0.12 | .043 J | .070 J | 0.36 J | <0.49 |
| Toluene | 0.17 J | <0.37 | <0.20 | <0.14 | 0.28 J | 2.5 | <0.11 | <.032 | .046 J | <0.1 | <0.45 |
| 1,1,1-TCA | 1.8 | 2.1 | 1.6 | 1.3 | 0.76 J | 1.1 | 0.27 J | 0.13 J | 0.22 J | 1.1 | 2.1 |
| TCE | 3.8 | 6.2 | 3.8 | 3.2 | 2.6 | 3.1 | 0.46 J | 0.24 J | 0.38 J | 2.3 | 4.8 |
| 1,1,2-trichloro-1,2,2-trifluoro-ethane | 0.73 | 0.67 J | 0.50 J | 0.44 J | 0.19 J | 0.60 J | 0.13 J | .043 J | .045 J | 0.33 J | 1.3 |
| Acetone | 0.82 | <1.2 | 0.80 J | <0.45 | 0.27 J | <0.34 | 0.34 J | <0.10 | 0.14 J | 0.58 J | <1.4 |

| | M1S | | M3S | | M4D | M6S | M7S | M10S |
|---|---|---|---|---|---|---|---|---|
| Compound⇓ Port⇒ | P1 | P3 | P1 | P2 | P1 | P1 | P1 | P3 |
| Depth (ft)⇒ | 566 | 319 | 559 | 505 | 555 | 588 | 547 | 357 |
| $CCl_4$ | 0.36 J | 0.16 J | 0.83 J | 1.8 | 0.69 J | 1.3 | 0.81 J | 2.3 |
| Chloroform | .064 J | .034 J | .078 J | 0.11 J | .086 J | .073 J | .049 J | 0.11 J |
| PCE | .018 J | <.014 | .038 J | .053 J | .030 J | .042 J | .038 J | 0.34 J |
| Toluene | .023J | <.013 | .028 J | .013 | 0.27 J | 0.93 J | .064 J | .090 J |
| 1,1,1-TCA | .029 J | .022 J | .066 J | 0.21 J | .050 J | 0.15 J | 0.11 J | 0.22 J |
| TCE | 0.14 J | .072 J | 0.22 J | 0.39 J | 0.14 J | 0.20 J | 0.17 J | 0.23 J |
| 1,1,2-trichloro-1,2,2-trifluoroethane | <.014 | <.014 | .018 J | .033 J | .029 J | .045 J | .033 J | 0.13 J |
| Acetone | 0.39 J | .062 J | <0.73 | 0.12 J | <.084 | .087 J | 0.21 J | .088 J |

**Table 1.** (continued).

| | WWW1 | | 8801 | 8902 | | D02 | |
|---|---|---|---|---|---|---|---|
| Compound⇓ Port⇒ | P1 | P3 | P4 | P6 | P6 | P2 | P2 |
| Depth (ft)⇒ | 240 | 135 | 78 | 71 | 71 | 60 | 60 |
| $CCl_4$ | 6.3 | 18 | 3000 | 1200 | 2500 | 1200 | 1300 |
| Chloroform | 0.93 J | 1.3 | 640 | 190 | 470 | 190 | 190 |
| PCE | 0.16 J | 0.65 J | <29 | 18 | <22 | 18 | 18 |
| Toluene | <.058 | <0.25 | <27 | <11 | <20 | <11 | <14 |
| 1,1,1-TCA | 0.36 J | 1.4 | 110 | 54 | 88 | 54 | 54 |
| TCE | 1.6 | 4.0 | 480 | 190 | 360 | 190 | 200 |
| 1,1,2-trichloro-1,2,2-trifluoroethane | 0.24 J | 0.56 J | <28 | 14 | 21 | 14 | <15 |
| Acetone | 0.64 J | <0.80 | <83 | <36 | <163 | <36 | <44 |

Note: Port numbers are preceded by a P. All concentrations are in parts per million volume (ppmv). 8902, and D02 have duplicate data for the same port numbers; both are shown here. J indicates that value is estimated below the contract required quantitation limit. A less than symbol (<) indicates that the sample contained less than the noted detection limit.

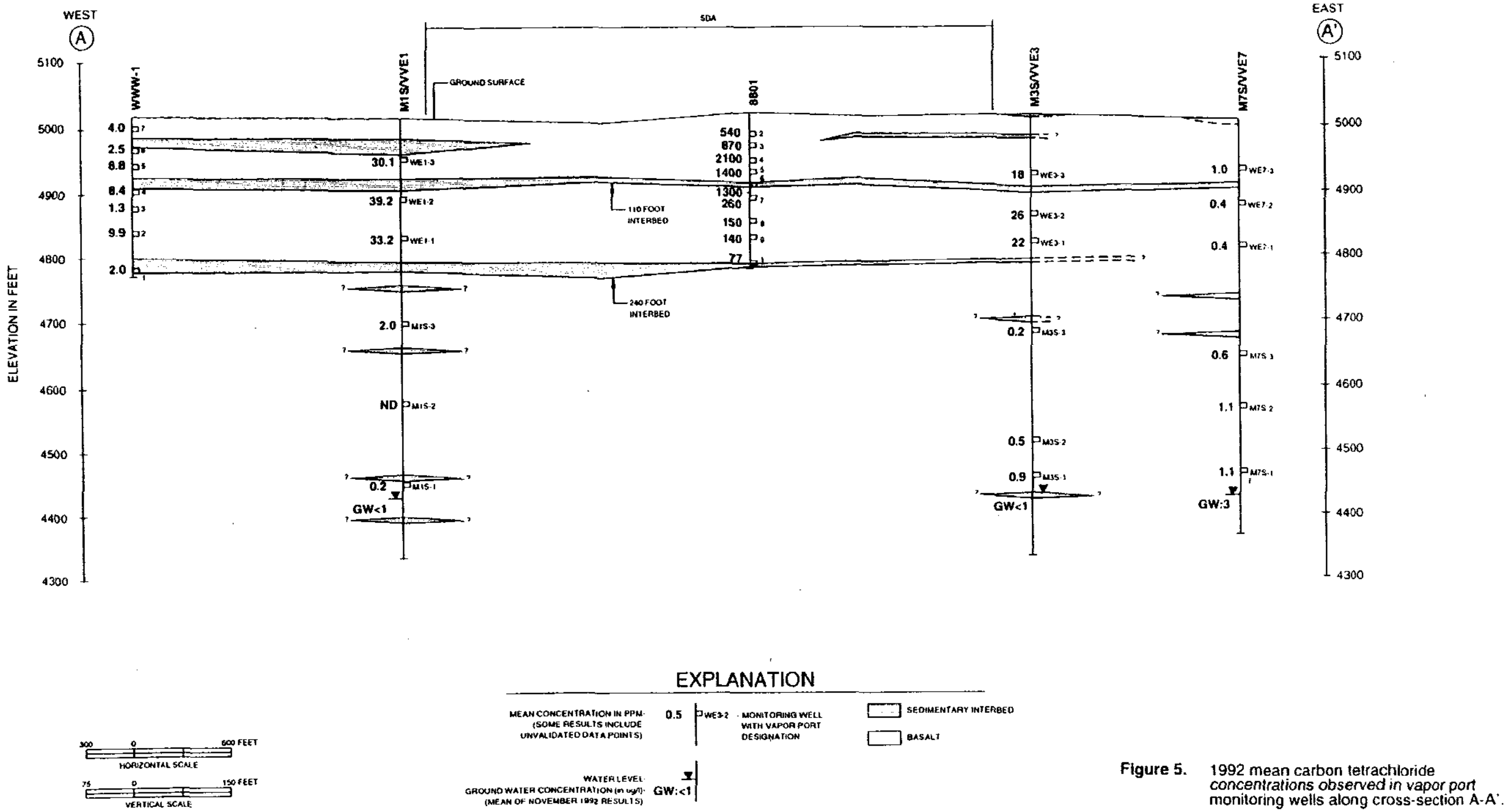


**Figure 5.** Mean $CCl_4$ subsurface vapor concentrations along cross-section A-A'.

**Perched Water**

Prior to 1992, perched water had been detected in seven wells or boreholes (Figure 6). Wells known to contain perched water were sampled in 1992. Only three wells, 77-2, USGS 92, and D10, yielded enough water for samples. Results of analyses on these samples for VOCs are summarized in Table 2. The highest VOC concentrations in perched water samples were detected in Well USGS 92. $CCl_4$, TCE, chloroform, and PCE were the VOCs with the highest concentrations within this well. The concentrations of these VOCs in Wells 8802D and D10 were an order of magnitude less than the concentrations found in USGS 92. The $CCl_4$ and TCE concentrations in all of the perched water samples exceed their respective MCLs; however, perched water is not used for any purpose in the RWMC area and is too limited in both vertical and lateral extent to provide a dependable source of water.

**Groundwater**

The results of sampling and analysis of groundwater in the SRPA from both USGS and new "M" series wells are illustrated on Figure 7. While no significant VOC contamination was present in monitoring wells upgradient of the SDA, VOCs were detected in all eight USGS wells and all six new "M" series monitoring wells located in the immediate vicinity of the SDA.

The most widely detected VOCs in USGS wells near the SDA were $CCl_4$ and TCE. The compounds detected in decreasing order of maximum historically detected concentrations are: $CCl_4$ [6.6 micrograms per liter (μg/l)], dichlorodifluoromethane (2.4 μg/l), TCE (1.4 μg/l), toluene (1.2 μg/l), chloroform (1.0 μg/l), and 1,1,1-TCA (0.9 μg/l). Only the $CCl_4$ concentration of 6.6 μg/l in Well USGS 88 was above its MCL of 5 μg/l. This sample was collected in 1987; all subsequent samples from this well have contained less than 5 μg/l. All other results for VOCs from samples collected in USGS wells have been below MCLs.

New monitoring Wells M1S, M3S, M4D, M6S, M7S, and M10S (Figure 7) were sampled and analyzed for VOCs three times between October 1992 and May 1993. Mean VOC concentrations in these new wells are listed in Table 3. Toluene had the highest mean concentrations of any of the VOCs in the new wells. Mean toluene concentrations ranged from not detected in Wells M3S and M6S to 1.0 μg/l in Wells M1S and M7S, 5.4 μg/l in Well M10S and 10.8 μg/l in Well M4D. $CCl_4$ concentrations of 1.7 and 3.3 μg/l were detected in Wells M6S and M7S, respectively. TCE was detected at a mean concentration of 2.0 μg/l in Well M7S. Methylene chloride was detected at a concentration of 2.3 μg/l in Well M1S. None of the detected concentrations in the new groundwater monitoring wells exceeded MCLs.

## 5.3 Results of VVE Treatability Studies

To provide information on the viability of vapor vacuum extraction (VVE) as a remedial process for the OCVZ, a treatability study was conducted at the SDA in 1993. The treatability study used a pilot-scale VVE system consisting of a vapor extraction well (8901D), a vacuum pump, and a vapor treatment system. Two carbon bed adsorbers placed in series were used to remove the VOCs from the extracted air. In addition to providing performance information on VVE, the treatability study yielded information on the characteristics of the vadose zone. This information is noted below.

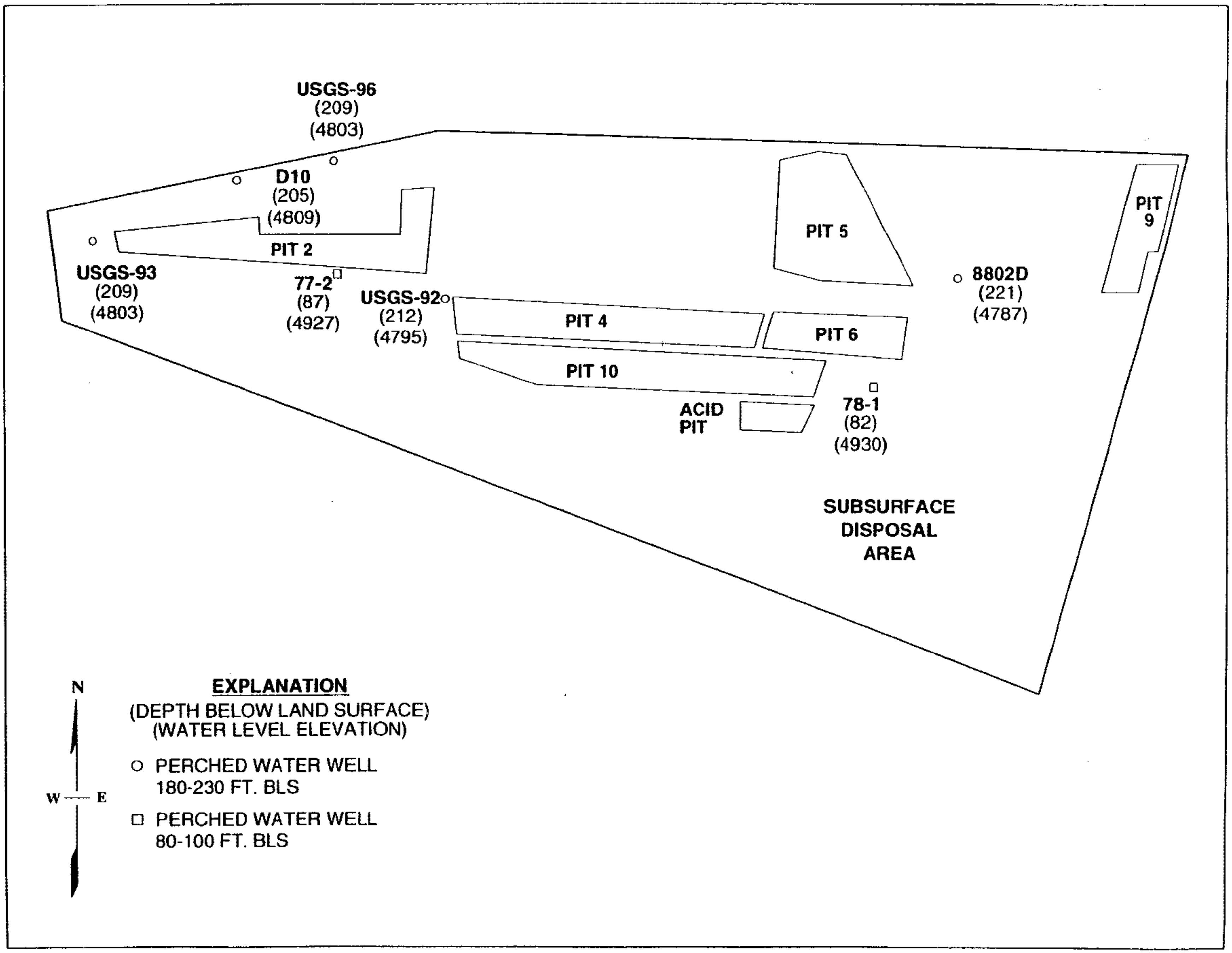


**Figure 6.** Location of wells that have contained perched water at the SDA.

**Table 2.** Concentrations of validated data for VOCs in perched water (μg/l or ppb).

| Parameter | Wells | | | | |
|---|---|---|---|---|---|
| | USGS 92 | 8802D | D10[b] | D10 | Trip blank |
| Methylene chloride | <100 | <10 | ND | ND | 1 |
| 1,1-dichloroethane | <100 | <10 | <1 | 0.3J | <1 |
| Chloroform (100)[a] | 1,500 | ND | ND | ND | 34 |
| 1,1,1-TCA (200)[a] | <100 | 15 | 3 | 3 | <1 |
| $CCl_4$ (5)[a] | 2100 | 190 | 18 | 21 | 0.4J |
| 1,1-dichloropropane | <100 | <10 | <1 | <1 | <1 |
| TCE (5)[a] | 1600 | 150 | 13 | 15 | <1 |
| 1,2-dichloropropane | <100 | <10 | 1 | 1 | <1 |
| Bromodichloromethane | <100 | <10 | <1 | <1 | 3 |
| Toluene (1000)[a] | <100 | 3J | 0.6J | 0.7J | <1 |
| PCE (5)[a] | 230 | 13 | 4 | 5 | <1 |
| Dibromochloromethane | <100 | <10 | <1 | <1 | 0.6J |
| Ethylbenzene | <100 | <10 | 0.5J | 0.7J | <1 |
| p&m-Xylene | <100 | <10 | 2 | 2 | <1 |
| Styrene | 9J | <10 | <1 | <1 | <1 |
| 1,2,4-trimethylbenzene | <100 | <10 | 0.2J | 0.2J | <1 |
| 1,2,4-trichlorobenzene | <100 | <10 | ND | <1 | 0.2 |
| Hexachlorobutadiene | ND | <10 | <1 | <1 | 1 |
| Napthalene | <100 | <10 | ND | 0.3BJ | 0.4 |
| 1,2,3-trichlorobenzene | <100 | <10 | <1 | <1 | <1 |

a. EPA Primary Drinking Water Standard 40 CR 141.61, μg/l or ppb.

b. Duplicate analysis conducted on sample from D10.

B = Compound was also detected in a blank

J = Estimated value below contract required quantitation limit

ND = Not detected, compound detected at higher levels in a blank.

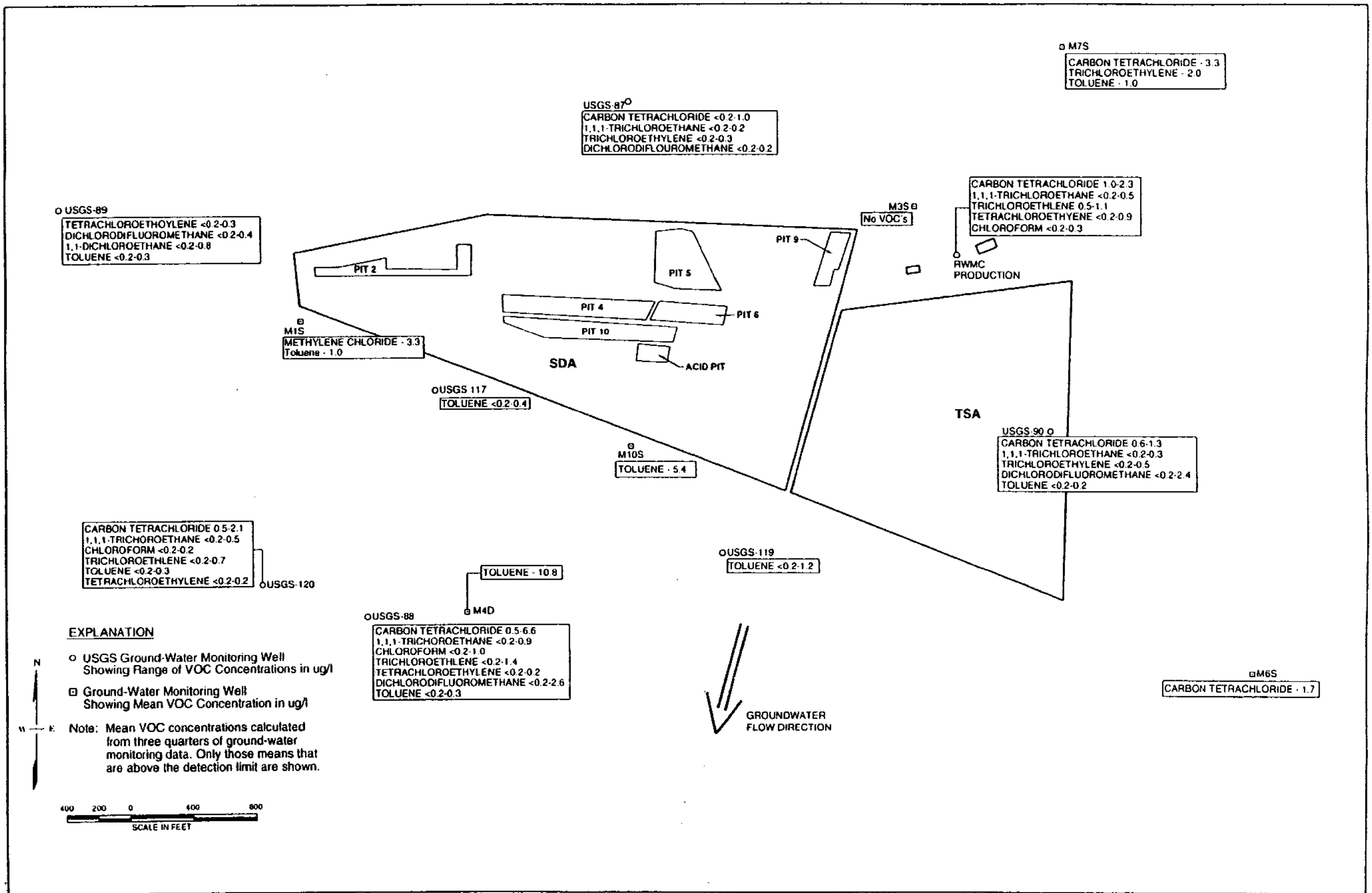


**Figure 7.** Summary of groundwater analyses for samples taken from the SRPA near SDA.

**Table 3.** Mean VOC concentrations in new groundwater monitoring wells (µg/l or ppb).

| VOCs | MCL | Detection limit | Wells | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | M1S | M3S | M4D | M6S | M7S | M10S |
| Methylene chloride | — | 1 | 2.3 | ND | ND | ND | ND | ND |
| Chloroform | 100 | 1 | ND | ND | ND | ND | ND | ND |
| 1,1,1-TCA | 200 | 1 | ND | ND | ND | ND | ND | ND |
| $CCl_4$ | 5 | 1 | ND | ND | ND | 1.7 | 3.3 | ND |
| TCE | 5 | 1 | ND | ND | ND | ND | 2.0 | ND |
| Bromo-dichloromethane | 100 | 1 | ND | ND | ND | ND | ND | ND |
| Toluene | 1,000 | 1 | 1.0 | ND | 10.8 | ND | 1.0 | 5.4 |
| PCE | 5 | 1 | ND | ND | ND | ND | ND | ND |
| 1,2-dichloroethane | — | 1 | ND | ND | ND | ND | ND | ND |

Note: Mean concentrations calculated by taking the mean of the mean concentrations for each of the three quarters of monitoring data. Mean concentrations below the detection limit of 1 µg/l reported as not detected.

ND = Not Detected.

Several tests were conducted during the 1993 treatability study to optimize VVE performance and to evaluate hydraulic characteristics of the vadose zone. During extraction well testing, a straddle packer was used to isolate various intervals to define zones of high permeability that could sustain high flowrates. These tests showed that a zone adjacent to the 110-ft interbed had the highest calculated permeability (15 darcies) and, therefore, the highest sustainable pumping rate. Extraction rate tests, in conjunction with vertical permeability study results, indicate that horizontal permeability varies considerably, ranging from less than 0.01 to 15 darcies, while vertical permeability ranges from 0.5 to 4 darcies.

When the treatability study began in April 1993, the total VOC concentration was approximately 1,000 parts per million volume (ppmv) in the extraction stream at a flowrate of about 170 cubic feet per minute (cfm). By June 3, 1993, the total VOC concentration dropped to 300 to 500 ppmv at the same flowrate. From June 3 to July 20, the system was not operated due to the need to replace spent carbon beds. After carbon bed replacement, the system was restarted on July 21 and the total VOC concentration had rebounded to approximately 600 ppmv in the extraction stream. The total VOC concentration stabilized and remained between 400 and 500 ppmv for the remainder of the treatability study. The 1993 treatability study operation recovered approximately 1,340 kg (2,900 lbs) of VOCs.

Long-term VVE testing showed that continued operation of the VVE system influenced VOC concentrations in vapor monitoring wells as far away as 450 ft from the extraction well. Concentrations in nearby vapor monitoring wells showed the greatest decreases in the 110-ft interbed but also decreased above and below the 110-ft interbed.

VOCs extracted during the treatability study were captured effectively from extracted vapor using carbon adsorption beds. These beds were shipped to an approved facility in Texas for final disposal at the completion of the treatability study.

# 6. SUMMARY OF SITE RISKS

The human health risk assessment for OCVZ evaluated both present and future potential exposures to contaminants. The risk assessments were conducted in accordance with the EPA *Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual* and *Volume II: Environmental Assessment Manual* and other EPA guidance. The risk assessment methods and results are summarized in the following sections.

## 6.1 Human Health Risks

The risk assessment consisted of contaminant identification, exposure assessment, toxicity assessment, and human health risk characterization. The organic contaminants identified for OCVZ were based on existing inventory records and site characterization data. The exposure assessment detailed the exposure pathways that exist at the site for workers, off-site residents and potential future on-site residents. The toxicity assessment documented the adverse effects that may be caused in an individual as a result of exposure to a contaminant associated with OCVZ.

The human health risk assessment evaluated current and future potential noncarcinogenic health effects and carcinogenic risks associated with exposure to organic contaminants identified in the waste inventory. The human health evaluation used both the exposure concentrations and the toxicity data to determine a hazard index for potential noncarcinogenic effects and an excess cancer risk level for potential carcinogenic contaminants. In general, when a hazard index exceeds one, there may be a concern for potential noncarcinogenic health effects. The excess cancer risk level is the increase in the probability of contracting cancer. The NCP acceptable risk range is 1 in 10,000 to 1 in 1,000,000 (i.e., $1 \times 10^{-4}$ to $1 \times 10^{-6}$). An excess lifetime cancer risk of 1 in 10,000 indicates that an individual has up to one chance in ten thousand of developing cancer over a lifetime of exposure to a site-related contaminant.

### 6.1.1 Identification of Contaminants of Concern

Organic contaminants of concern (COCs) evaluated in the baseline risk assessment were selected based on historical waste records and on the nature and extent of these contaminants in vadose zone media. The COCs selected for OCVZ are $CCl_4$, PCE, TCE, and 1,1,1-TCA. These compounds have been identified as known waste constituents.

Chloroform was not identified in the waste history for the SDA; however, it was detected in site monitoring samples. Investigations pertaining to this contaminant indicate that the chloroform may have two sources, both of which are difficult to quantify. Dose reconstruction activities for the Rocky Flats Plant in Colorado have identified chloroform usage associated with weapons component production; however, the presence of chloroform in the INEL waste is not documented. Chloroform may also have resulted from anaerobic degradation of $CCl_4$, a known contaminant at the SDA. Therefore, chloroform may have either been initially present in the waste as a source term (but not reported), or it may have been produced by degradation of $CCl_4$. Since estimates from these potential sources have not been quantified, it is impossible to quantitatively evaluate the risk to human receptors from the migration of chloroform. Similarly, no data are available which document the presence of acetone or toluene in the waste. As such, chloroform, acetone, and toluene were not identified as COCs. The uncertainty associated with not including these contaminants in the risk assessment is discussed in Section 6.1.5.

### 6.1.2 Exposure Assessment

An exposure assessment was performed to estimate the magnitude, frequency, duration, and routes of human exposure to the organic contaminants present in the vadose zone.

### Exposed Populations

Only exposure pathways deemed to be complete (i.e., where a plausible route of exposure can be demonstrated from the site to an individual) were quantitatively evaluated in the risk assessment. The populations at risk due to exposure to organic COCs present in the vadose zone were identified by considering both current and future land use scenarios.

The human health risk assessment evaluated carcinogenic risks and noncarcinogenic health effects for the period from 1992 through 2121. This window of time for evaluating risks was selected because it is during this time that peak contaminant concentrations occur in the SRPA. The period was further divided into three current and future use time periods:

1. Current period (1992–2021). Control of the RWMC will be maintained by the DOE during this period of time. Potential exposures to on-site workers or visitors and residents adjacent to the INEL were evaluated. Institutional control of the RWMC is defined in an Institutional Control Plan for the INEL per DOE Order 5820.2a.

2. Institutional control period (2022–2091). Control of the RWMC will be maintained by the DOE during this period of time. Institutional controls would be implemented to control the facility and may include, but are not limited to, restricting land use, controlling public access, and the posting of signs, fencing, or other barriers. Potential exposures to on-site workers or visitors and residents adjacent to the INEL were evaluated.

3. Post-institutional control period (2092–2121). Only potential exposures on residents were evaluated for this time period. Hypothetical residents were evaluated at 200 meters (which is approximately the distance from the center of the SDA to its boundary), 500 meters, and 5,200 meters from the center of the SDA. Each of these three locations is southwest of the SDA—the normal direction of flow for the SRPA. Note that the 5,200 meter location is the southern INEL boundary.

### Exposure Pathways

The following exposure pathways were evaluated in the risk assessment for the current, institutional, and post-institutional control periods. In order to complete the pathways evaluation, contaminant fate and transport modeling was performed. The use of modeling is discussed in the following section.

- Outdoor inhalation of organic vapors
- Indoor inhalation of organic vapors
- Indoor inhalation of organic vapors released from indoor use of groundwater
- Dermal contact with groundwater
- Ingestion of groundwater (by hypothetical residents only).

Ingestion of contaminated groundwater by workers during the current and institutional control periods was not considered a viable pathway because the water supplied to workers from the RWMC production well is tested for contaminants. If contaminants in this well were to exceed MCLs, the water would be treated, or water from an uncontaminated source would be supplied to the workers.

The estimated risks and potential health effects associated with the pathway of dermal contact with groundwater turned out to be very low relative to the pathways of inhalation and ingestion. As such, for purposes of summarizing risk in this ROD, following discussions focus on inhalation and ingestion. Details for all of the pathways considered can be found in Sections 5 and 6 of *Remedial Investigation/Feasibility Study Report for the Organic Contamination in the Vadose Zone—Operable Unit 7-08* (EGG-ER-10684).

### Contaminant Fate and Transport Modeling

A two-dimensional numerical transport model was developed to characterize the migration of contaminants from the disposal pits, through the vadose zone to the SRPA and to the atmosphere. Two additional models used the results of the vadose zone modeling to subsequently simulate the transport of contaminants in the SRPA and in the atmosphere. Also, the vadose zone model results were used to calculate COC concentrations in hypothetical building basements.

The computer code PORFLOW Version 2.39 was used to simulate transport of contaminants in the vadose zone. The source term of the model was based on Kudera's estimates which are described in Section 5.2. The model was calibrated using 1992 vapor concentration measurements of $CCl_4$ from wells instrumented with vapor sampling ports. The model was then used to predict the mass flux of each COC to the atmosphere and the SRPA from 1966 to the year 2193. The material properties used in the model are based on data collected during the RI, historical data, and calibration of the model.

The vadose zone model results provide mass fluxes to the air and groundwater pathways as a function of time and provide the basis for COC concentrations at receptor locations. As expected, the $CCl_4$ flux is higher than the other COCs. The peak flux to the atmosphere for each COC occurs shortly after disposal ceased in 1970. $CCl_4$ flux to groundwater is predicted to peak in 2071, with flux to groundwater of the other COCs peaking in 2074.

A two dimensional transient analytical model, AT123D, was used to simulate the migration of COCs in the SRPA from beneath the SDA and predict concentrations of the four COCs through time (1966 through 2193) at three receptor locations downgradient. ISCLT Version 2.0 was used to model airborne contaminant transport to predict maximum average concentrations of COCs in air at specified receptor locations. The predicted groundwater and air concentrations were then used in the baseline risk assessment.

Results of the vadose zone model were also used to estimate COC vapor concentrations in hypothetical building basements at the 200 and 500 meter receptor locations for use in the baseline risk assessment. Estimates of building concentrations were made with a simple mixing equation for each exposure period. This equation assumes instantaneous mixing and steady state conditions for each time period. The results of this model are building concentrations for 1966 through 2193 for each COC for the 200 and 500 meter receptor locations. These concentrations were then used in the baseline risk assessment.

### Exposure Point Concentrations

COC concentrations at points where the potential for human exposure is expected to occur are necessary to evaluate the intake of potentially exposed individuals. The contaminant fate and transport models described above provided COC concentrations in both air and groundwater at selected exposure point locations.

COC transport modeling indicated that the flux of COCs from the vadose zone to the atmosphere and the resultant airborne COC concentrations have peaked and will continue to decrease through the current, institutional, and post-institutional control periods. As such, exposure to airborne COCs will be greatest during the current control period. Figure 8 shows total COC emission to the atmosphere over time. The emission of COCs to the atmosphere results in an airborne COC concentration during the current period that ranges from approximately 15 $\mu g/m^3$ at the WAG 7 boundary (200 m from center of SDA) to 0.00637 $\mu g/m^3$ at the southern INEL boundary (5,200 m from center of SDA).

Unlike the airborne COC concentrations, the COC concentrations in groundwater will not peak until around the year 2071, which is during the latter part of the institutional control period. As shown in Figure 9, each COC peaks at a different concentration, with $CCl_4$ peaking the highest at approximately 125 $\mu g/l$ or ppb. Three of the COCs, $CCl_4$, TCE, and PCE are predicted to remain above MCLs beginning early in the current period and extending beyond the institutional control period. The concentrations shown on Figure 9 are predicted for groundwater at the SDA boundary.

Detailed discussions on exposure point concentrations can be found in Volume I, Section 5 of the *Remedial Investigation/Feasibility Study Report for the Organic Contamination in the Vadose Zone—Operable Unit 7-08* (EGG-ER-10684).

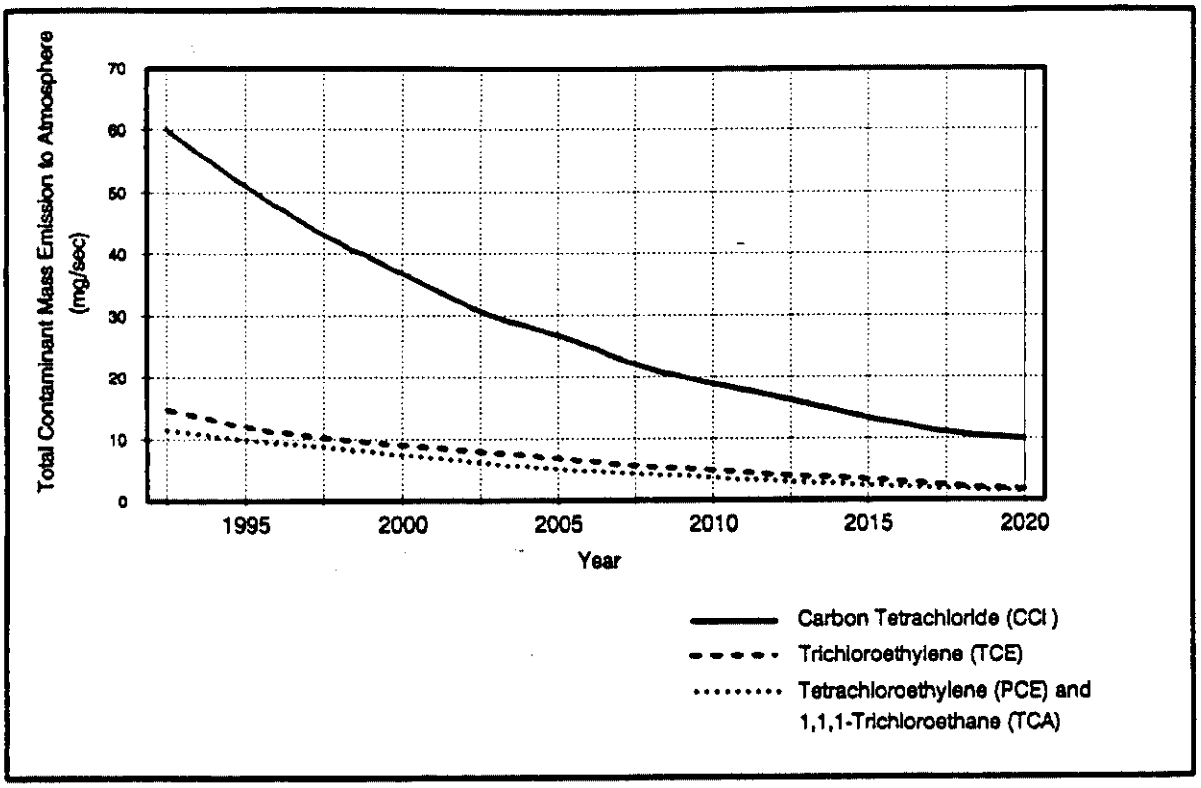


**Figure 8.** Total COC emission to the atmosphere over time.

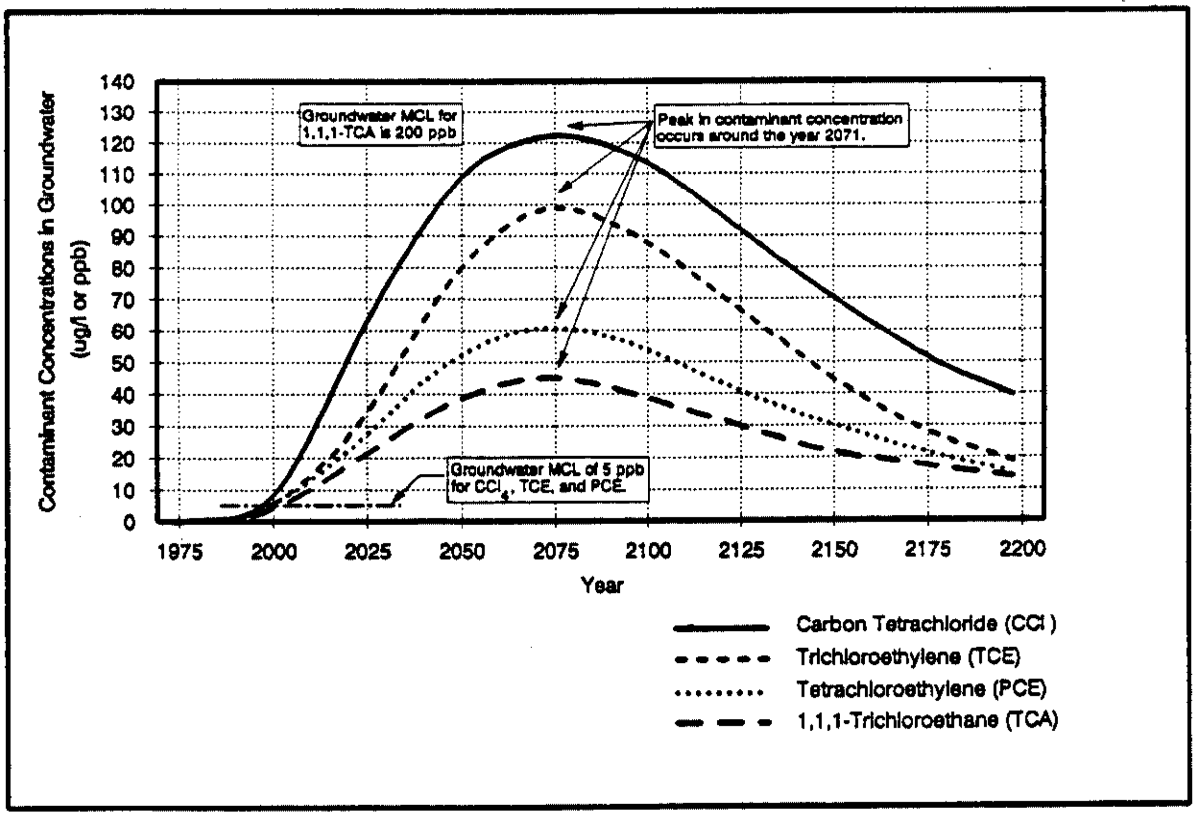


**Figure 9.** COC concentrations in the SRPA at the SDA boundary over time.

### 6.1.3 Toxicity Assessment

The toxicity assessment addresses the potential for a contaminant to cause adverse effects in exposed populations and estimates the relationship between extent of exposure and extent of toxic injury (i.e., dose response relationship).

Two types of toxicity values were used in the risk assessment: chronic reference doses, which are used to evaluate noncarcinogenic effects; and slope factors, which are used to evaluate carcinogenic effects. The Integrated Risk Information System (IRIS) database, an EPA online computer database, and the EPA Health Effects Assessment Summary Tables (HEAST) provided toxicity values and slope factors for the COCs present at OCVZ. These reference doses and slope factors are listed in Tables 4 and 5, respectively. Reference doses and slope factors are "pathway specific;" that is, they are dependent on the means of contaminant exposure.

The COCs, except for 1,1,1-TCA, are known carcinogens that target the liver and lungs. The potential carcinogenic effects of 1,1,1-TCA cannot be evaluated due to insufficient data on the carcinogenic effects of this compound. Each of the contaminants has harmful noncarcinogenic effects (both acute and chronic) on the central nervous system, liver, and lungs.

### 6.1.4 Risk Characterization

Risk characterization is the process of combining the results of the exposure and toxicity assessments. This process provides numerical quantification relative to the existence and magnitude of potential public health concerns related to the potential release of contaminants from the site. Exposure parameters, such as exposure frequency and duration, used in the risk assessment were obtained from Standard Default Exposure Factors guidance (EPA *Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual, Supplemental Guidance, Standard Default Exposure Factors*, OSWER Directive 9285.6-03, 1991). The exposure parameters used are shown in Table 6. As noted earlier, the summary format of this ROD focuses on inhalation and ingestion because, relative to these pathways, dermal absorption contributed very little health risks or effects.

Risk calculations are divided into carcinogenic and noncarcinogenic categories. The calculation of health risks from potential exposure to carcinogenic compounds involves the multiplication of cancer slope factors for each carcinogen and the estimated intake values for that contaminant. Noncarcinogenic health effects are assessed by comparison of an estimated daily intake of a contaminant to its applicable reference dose. A reference dose is a provisional estimate of the daily exposure to the human population that is likely to be without an appreciable risk of deleterious effects during a portion of an individuals lifetime. The estimated daily intake of each contaminant by an individual route of exposure is divided by its reference dose and the resulting quotients are added to provide a hazard index.

Carcinogenic risk and noncarcinogenic health effects associated with OCVZ are summarized in Table 7. As shown in this table, carcinogenic risks are estimated to be below or within the acceptable risk range of $1 \times 10^{-4}$ to $1 \times 10^{-6}$ for all receptors under the current period and for the worker receptors under the institutional control period. An estimated two additional residential receptors out of 10,000 ($2 \times 10^{-4}$) are at risk of developing cancer as a result of the use of contaminated

**Table 4.** Constants for evaluating noncarcinogenic health effects from exposure to COCs.

| Chemical | Chronic reference doses | | | Subchronic RfD (mg/kg/day) | Total organ |
|---|---|---|---|---|---|
| | Oral (mg/kg/day) | Inhalation (mg/kg/day) | Inhalation ($\mu g/m^3$) | | |
| $CCl_4$ | $7 \times 10^{-4}$ [a] | $1.8 \times 10^{-3}$ [b] | 6.1[b] | $7 \times 10^{-3}$ [c] | Liver |
| PCE | $1 \times 10^{-2}$ [d] | $1 \times 10^{-2}$ [e] | 35[e] | $1 \times 10^{-1}$ [f] | Liver |
| TCE | NA | NA | NA | NA | Lung/Liver |
| 1,1,1-TCA[g] | $9 \times 10^{-2}$ [h] | $3 \times 10^{-1}$ | $1 \times 10^{0}$ | $9 \times 10^{-1}$ | Liver |

a. IRIS (2/93). Last update 10/7/92.

b. Calculated from oral RfD assuming inhalation: oral absorption ratio of 0.4 (see carcinogenicity data table).

c. HEAST (1992)

d. IRIS (2/93). Last update 4/6/92.

e. Calculated from oral RfD assuming an inhalation volume of 20 $m^3$/day for a 70-kg adult. No correction for relative absorption efficiency.

f. HEAST (1991).

g. Information from HEAST (1991). Last IRIS update 10/7/92.

h. Notes in HEAST (1991) indicate that this value is based on extrapolation from inhalation data. The assumed relative absorption efficiency (inhalation: oral) appears to be 0.3.

**Table 5.** Constants for evaluating carcinogenic effects associated with exposure to the COCs.

| Chemical | Weight of evidence classification | Target organ | Slope factors: Oral $(mg/kg/day)^{-1}$ | Inhalation unit risks $(mg/kg/day)^{-1}$ | Inhalation unit risks $(\mu g/m^3)^{-1}$ |
|---|---|---|---|---|---|
| $CCl_4$[a] | B2 | Liver | 0.13 | $5.3 \times 10^{-2}$ [b] | $1.5 \times 10^{-5}$ [c] |
| PCE[d] | B2 | Liver | $5.1 \times 10^{-2}$ | $1.8 \times 10^{-3}$ [e] | $5.2 \times 10^{-7}$ |
| TCE[f] | B2 | Lung, liver | $1.1 \times 10^{-2}$ | $1.7 \times 10^{-2}$ | $1.7 \times 10^{-6}$ |

a. Information from IRIS (accessed 2/93); last update 10/7/92.

b. Calculated from inhalation unit risk assuming inhalation rate of 20 $m^3$/day by a 70-kg adult.

c. As described in IRIS (2/93), this value is calculated from the oral slope factor assuming that absorption efficiency via inhalation is 40% of absorption efficiency via the oral route.

d. Information from HEAST (1991). Last IRIS update 4/6/92.

e. Calculated from inhalation unit risk. No correction for inhalation absorption efficiency has been made.

f. Information from HEAST (1991). Last IRIS update 8/7/92.

**Table 6.** Parameters used to model inhalation and ingestion exposures by current and future receptors.

| Parameter | Receptor group | RME value | Reference |
|---|---|---|---|
| <u>Inhalation</u> | | | |
| Respiration Rate (RR) | Adult/child | 20 $m^3$/day (total)<br>15 $m^3$/day (indoor) | EPA RAGS[a] |
| Exposure Frequency (EF) | Adult/child | 350 days/year | EPA RAGS |
| | Worker | 250 days/year | |
| Exposure Duration (ED) | Adult | 24 years | EPA RAGS |
| | Child | 6 years | |
| | Worker | 25 years | |
| Body Weight (BW) | Adult/worker | 70 kilogram (kg) | EPA RAGS |
| | Child | 15 kg | |
| Averaging Time (AT) | Adult | 8,760 days (noncarcinogens) | EPA RAGS |
| | Child | 2,190 days (noncarcinogens) | |
| | Worker | 9125 days (noncarcinogens) | |
| | Adult/worker | 25,550 days (carcinogens) | |
| <u>Ingestion</u> | | | |
| Ingestion Rate (IR) | Adult<br>infant (0-3 years)<br>child (3-6 years) | 2.0 l/day<br>0.53 l/day<br>0.74 l/day | EPA RAGS<br>EPA[b]<br>EPA[b] |
| Exposure Frequency (EF) | Adult/child | 350 days/year | EPA RAGS |
| Exposure Duration (ED) | Adult | 24 years | EPA RAGS |
| | Child | 6 years | |
| Body Weight (BW) | Adult | 70 kg | EPA RAGS |
| | Child | 15 kg | |
| Average Time (AT) | Adult | 8,760 days (noncarcinogens) | EPA RAGS |
| | Child | 2,190 days (noncarcinogens) | |
| | Adult | 25,550 days (carcinogens) | |

a. Risk Assessment Guidance for Superfund (RAGS), U.S. EPA, 1991.

b. Statement of Work RI/FS Risk Assessment Deliverables, EPA Region 10, U.S. EPA, 1990.

**Table 7.** Summary of baseline risk assessment results.

| Receptor[a] | Exposure timeframe | Carcinogenic risk[b] | Noncarcinogenic risk (hazard index)[c] | Primary contributing exposure route |
|---|---|---|---|---|
| Current Scenario (1992 to 2021) | | | | |
| Worker—200 meters | 1992–2016 | 6 in 100,000 ($6 \times 10^{-5}$) | 2 | Air |
| Worker—500 meters | 1992–2016 | 4 in 1,000,000 ($4 \times 10^{-6}$) | 0.1 | Air |
| Resident adult—5,200 meters | 1992–2021 | 1 in 100,000 ($1 \times 10^{-5}$) | 0.3 | Groundwater |
| Resident child—5,200 | 1992–2021 | —[d] | 0.3 | Groundwater |
| Institutional Control Scenario (2022 to 2091) | | | | |
| Worker—200 meters[e] | 2062–2086 | 9 in 10,000,000 ($9 \times 10^{-7}$) | 0.03 | Air |
| Worker—500 meters[e] | 2062–2086 | 2 in 1,000,000 ($2 \times 10^{-6}$) | 0.07 | Air |
| Resident adult—5,200 meters | 2062–2091 | 2 in 10,000 ($2 \times 10^{-4}$) | 5 | Groundwater |
| Resident child—5,200 meters | 2062–2091 | —[d] | 6 | Groundwater |
| Post-Institutional Control Scenario (2092 to 2121) | | | | |
| Resident adult—200 meters | 2092–2121 | 2 in 10,000 ($2 \times 10^{-4}$) | 6 | Groundwater |
| Resident child—200 meters | 2092–2121 | —[d] | 5 | Groundwater |
| Resident adult—500 meters | 2092–2121 | 2 in 10,000 ($2 \times 10^{-4}$) | 3 | Groundwater |
| Resident child—500 meters | 2092–2121 | —[d] | 7 | Groundwater |
| Resident adult—5,200 meters | 2092–2121 | 2 in 10,000 ($2 \times 10^{-4}$) | 5 | Groundwater |
| Resident child—5,200 meters | 2092–2221 | —[d] | 5 | Groundwater |

a. Risks are calculated for three different distances from receptor to center of SDA. 200 meters = 656 ft, 500 meters = 1,640 ft, 5,200 meters = 17,060 ft.

b. The NCP defines an acceptable level of carcinogenic risk as less than 1 additional incidence of cancer in 10,000 to 1,000,000 individuals (i.e., $1 \times 10^{-4}$ to $1 \times 10^{-6}$).

c. A hazard index (the ratio of the level of exposure to an acceptable level) greater than 1 indicates that there may be concern for noncarcinogenic effects. Hazard indices listed are cumulative across all exposure pathways.

d. Carcinogenic risks are calculated for the population exposed over a period of time to contaminant concentrations for which cancer is typically observed.

e. Concentration of $CCl_4$ in the SRPA beneath the SDA is predicted by the model to peak in the year 2071 at a concentration of about 125 mg/m$^3$ (ppb). However, ingestion of groundwater by workers during the institutional control scenario was not considered in the risk assessment due to institutional controls preventing the use of SRPA water above MCLs by workers.

groundwater during the latter part of the institutional control period and the post-institutional control period. The risk increases with increasing concentrations of contaminants in groundwater. Therefore, organic contamination in the vadose zone, if not addressed by a remediation alternative, could migrate to the SRPA and contaminate the groundwater to a degree that results in risks to human health of $2 \times 10^{-4}$, which is slightly greater than the acceptable risk range. In addition, concentrations of $CCl_4$, TCE, and PCE in groundwater are predicted to peak above their respective MCLs (see Figure 9).

The hazard indices estimated for the current period are less than 1 except for the worker at the SDA boundary. The estimated hazard index of 2 for the current worker is related to outdoor inhalation of organic contaminants. This estimate is based on conservative assumptions associated with exposure duration and the air model used to predict outdoor concentrations of organic contaminants. Due to the conservative nature of these assumptions, the actual hazard index for this receptor is expected to be less than 1. Generally, hazard indices greater than 1 indicate that the potential exists for noncarcinogenic effects to be seen in exposed individuals. For the institutional and post-institutional control periods, hazard indices greater than 1 were calculated for each of the residential receptors. The primary exposure routes for these hazard indices are ingestion of groundwater and inhalation of organic vapors released from indoor use of groundwater.

### 6.1.5 Uncertainty

Risk assessments are subject to uncertainty from inventory records, sampling and analysis, fate and transport estimation, exposure estimation, and toxicological data. Uncertainty was addressed by using health protective assumptions that systematically overstate the magnitude of health risks. This process is intended to bound the plausible upper limits of risk and to facilitate an informed risk management decision. Table 8 is a summary of risk assessment uncertainty factors and their effects on the modeling results.

## 6.2 Environmental Concerns

In order for organic contaminants to elicit adverse ecological impacts, credible pathways of ecological exposure must be identified. Three potential pathways of exposure are:

- Absorption or inhalation of vapors through the airborne route

- Uptake or ingestion of groundwater containing COCs which have migrated from the vadose zone to the saturated zone

- Direct exposure or uptake from burrowing or root penetration of the vadose zone contamination.

Modeling suggests that the peak concentration of volatilized COCs measured at the ground surface has already occurred and will continue to decrease with time. The groundwater pathway is not currently a complete pathway because groundwater is not being developed for irrigation at the Site. The concentration of COCs in groundwater are expected to peak and begin to decline during the institutional control period. Lastly, because COC concentrations in soil were extremely low or

**Table 8.** Uncertainty factors, OU7-08, INEL.

| Uncertainty factor | Effect of uncertainty | Comment |
|---|---|---|
| | Sampling and analysis | |
| Vapor plume extent | May slightly over- or under-estimate risk | Since the source term is static, a larger vapor plume would affect a larger exposure area, but result in reduced concentrations. |
| Detection limits/COC screening | May slightly over- or under-estimate risk | Measurements used in COC screening had different detection limits in the laboratory equipment than in the field equipment. However, since maximum concentrations are used in screening, the effect is expected to be small. |
| Exclusion of surface soil from the sampling and analysis program | May slightly under-estimate risk | Since the COCs are volatile, they would volatilize from surface soils. Therefore, sampling and analysis was not conducted for this medium. Surface soil is the subject of OU7-05. |
| | Fate and transport estimation | |
| Assumed house volume and ventilation rate | May slightly over- or under-estimate risk | The indoor concentration of soil gas penetrating the foundation depends on indoor ventilation. |
| Near field indoor soil-gas concentrations | May over- or under-estimate risk | Indoor soil-gas concentrations at 200 m were assumed equal to modeled concentrations at 500 m, since the model assumptions do not facilitate near-field resolution. |
| Source term assumptions | May over- or under-estimate risk | The heterogeneous sources (pits) were assumed to be a homogeneous disk of 200 m in radius. Chloroform may have been present in the source term, but not recorded. |
| Natural infiltration rate | May over-estimate risk | A conservative value was used for this parameter. |
| Moisture content | May over- or under-estimate risk | This varies seasonally in the upper vadose zone and may be subject to measurement error. |

**Table 8.** (continued).

| Uncertainty factor | Effect of uncertainty | Comment |
|---|---|---|
| | Fate and transport estimation (continued) | |
| Modeling use of a 100 foot screen interval | May over- or under-estimate risk | Active thickness of SRPA is 250 ft. |
| Volume of theoretical mixing space in near-field air dispersion model | May over-estimate risk | The initial source term area for the vadose zone model was used, although the surface flux will be emitted over a larger area. |
| | Exposure estimation | |
| Receptor locations | May over- or under-estimate risk | Receptors were located in the direction of highest contaminant concentrations which would tend to overestimate actual exposure. However, if a resident lives on top of the SDA, the calculated exposure is an underestimation of actual exposure. |
| Exposure duration | May over-estimate risk | The assumption that an individual will work at the RWMC or reside at the INEL boundary for 25 or 30 years is conservative. |
| Exclusion of food pathway | May under-estimate risk | VOC uptake by homegrown vegetables is considered a negligible exposure route. |
| Non chemical-specific constants (e.g., exposure parameters such as inhalation rates, exposure duration, etc.) | May over-estimate risk | Conservative or upper bound values were used for all parameters incorporated into intake calculations |
| Contaminant concentrations | May over-estimate risk | Assumptions regarding contaminant concentrations as averages centered around peak concentrations may not characterize actual exposures. |
| Assumed aquifer mixing depth of 100 ft. | May over- or under-estimate risk | Wood (1991) indicates that the active depth of the aquifer is estimated to be 250 ft. However, for receptors close to the source, mixing depth is mostly dependent on the screened interval of the well. |

**Table 8.** (continued).

| Uncertainty factor | Effect of uncertainty | Comment |
|---|---|---|
| | Exposure estimation (continued) | |
| Assumed hydraulic conductivity of 700 ft/day | May over- or under-estimate risk | Higher hydraulic conductivities may send the plume to receptors faster, but may disperse contaminants faster as well. |
| Model does not consider biotic decay | May over-estimate risk | Biotic decay would tend to reduce contamination over time. However, the modeling effort did not account for this process. |
| Exclusion of chloroform | May under-estimate risk | Chloroform may be either a source or transformation product. Its detection is sporadic and was not modeled. |
| Exclusion of transformation products | May under-estimate risk | Not all transformation products of the identified organic compounds were evaluated. |
| | Toxicological data | |
| Use of cancer slope factors | May over-estimate risk | Potencies are upper 95th percentile confidence limits. Considered unlikely to underestimate true risk. |
| Critical toxicity values derived primarily from animal studies | May over- or under-estimate risk | Extrapolation from animal to humans may induce error due to differences in absorption, pharmacokinetics, target organs, enzymes, and population variability. |
| Critical toxicity values derived primarily from high doses, most exposures are at low doses | May over- or under-estimate risk | Assumes linear at low doses. Tend to have conservative exposure assumptions. |
| Critical toxicity values and classification of carcinogens | May over- or under-estimate risk | Not all values represent the same degree of certainty. All are subject to change as new evidence becomes available. |

**Table 8.** (continued).

| Uncertainty factor | Effect of uncertainty | Comment |
|---|---|---|
| | Toxicological data (continued) | |
| Lack of RfDs | May under-estimate risk | Inhalation RfDs are not available for TCE. |
| Effect of absorption | May over- or under-estimate risk | The assumption that absorption is equivalent across species is implicit in the derivation of the critical toxicity values. Absorption may actually vary with chemical. |
| Dermal absorption toxicity values | May slightly under-estimate risk | The unavailability of consensus absorption values does not facilitate comparison of absorbed dose to toxicity constants based on administered dose. |

not detected, plants and burrowing animals are not expected to be adversely affected by COCs at the Site. Therefore, while it is acknowledged that potential ecological receptors are currently present on-Site, contact with COCs is unlikely under current Site conditions.

Consequently, an ecological risk assessment was not conducted for the OCVZ RI/FS. The ecological impacts from OCVZ COCs will be evaluated in the comprehensive WAG 7 RI/FS (OU 7-14).

## 6.3 Basis for Response

Actual or threatened releases of hazardous substances from this site, if not addressed by implementing the response action selected in this ROD, may present an imminent and substantial endangerment to public health, welfare, or, the environment.

# 7. DESCRIPTION OF ALTERNATIVES

Remedial action alternatives were developed and analyzed in detail for the OCVZ operable unit. Prior to developing alternatives, remedial action objectives were established. These objectives and descriptions of the developed alternatives are included in the following sections.

## 7.1 Remedial Action Objectives

The intent of the remedial action objectives is to set measurable goals for protection of human health and the environment. The goals are designed specifically to mitigate the potential adverse effects that could result from the continued migration of the vadose zone COCs to the air or groundwater.

The risk assessment indicates that there is a current and future risk to workers and a future risk to the public due to the organic contaminants present in the vadose zone beneath and within the immediate vicinity of the RWMC. For workers, the primary contributing exposure route is inhalation of air contaminated with organic vapors that migrate upward from the vadose zone to the atmosphere. Exposure to contaminated groundwater was not considered a complete exposure pathway for current and future on-site workers due to the fact that if contaminant concentrations in the RWMC production well exceed permissible standards, the water would be treated or water would be supplied to workers from an uncontaminated source. For public receptors, the primary contributing exposure route was the use of groundwater. The baseline risk assessment concluded that future residential exposure to groundwater both on- and off-site would result in carcinogenic risks and noncarcinogenic hazards that are unacceptable. In addition, modeling of contaminant migration through the vadose zone and into the SRPA indicated that contaminant concentrations in the aquifer would continue to increase until sometime around the year 2071, at which time they would begin to decrease (see Figure 9 in Section 6). The resultant contaminant concentrations in groundwater could continue to remain above Federal and state MCLs for a period of several hundred years.

The results of the RI and baseline risk assessment indicated that the contamination of groundwater due to the migration of the vadose zone organic contaminants to the SRPA will present the most significant future risk to human health if no action is taken. Specifically, the baseline risk assessment indicated that the highest risk to a human receptor from the inhalation of contaminants emanating from the vadose zone is on the order of $10^{-5}$, while the highest risk from the future ingestion of contaminated groundwater is on the order of $10^{-4}$. The baseline risk assessment also shows that the risk from the inhalation of vapors emanating from the subsurface is at or below the $10^{-6}$ level for all of the future risk scenarios. That is, contaminant flux to the atmosphere has already peaked and will continue to decrease naturally. These results suggest that the primary objective of the FS should be to develop alternatives that would prevent vapor-phase organic contaminants in the vadose zone from reaching groundwater in concentrations that would result in future groundwater contaminant concentrations that exceed Federal and state MCLs. The MCLs result in an overall risk value within the acceptable range of $10^{-4}$ to $10^{-6}$. As such, the primary remedial action objective, and the focus of remedial action alternative development, is to ensure that risks to future groundwater users are within acceptable guidelines and that future contaminant concentrations in the aquifer remain below Federal and state MCLs. To ensure that this remedial action objective is met and maintained, a long-term groundwater and soil vapor monitoring program would be conducted. The monitoring program would be designed to provide an early indication of the possibility of future groundwater contamination above acceptable levels.

Remedial action objectives also include the identification of preliminary remediation goals (PRGs) that are established based on both risk and frequently used standards referred to as Applicable or Relevant and Appropriate Requirements (ARARs). PRGs are typically expressed as contaminant concentrations (i.e., cleanup levels) desired after a remedial action for various contaminated media. Contaminants associated with OCVZ are primarily organic vapors of $CCl_4$, TCE, PCE, 1,1,1-TCA, and chloroform present in the vadose zone. Because there are currently no ARAR-based standards available for determining cleanup levels for organic vapors in subsurface soils, an approach using groundwater MCLs to estimate PRGs for OCVZ was used. Such an approach relied on the contaminant fate and transport modeling, which was used as part of the baseline risk assessment, to estimate cleanup levels that would satisfy the primary remedial action objective. The fate and transport modeling predicts PRG levels for $CCl_4$, which is the COC present in the most significant concentrations, that may range from 30 to 200 ppmv, depending on the location within the vadose zone. The other COCs are predicted to have similar PRG levels that also vary depending on the location within the vadose zone. The PRGs only apply to alternatives that focus on removal of the COCs from the vadose zone; however, the remedial action objectives apply to any alternative.

The PRG range of 30 to 200 ppmv for $CCl_4$ is an estimate based on information available to date. Any alternative that removes COCs from the vadose zone would also include steps to further define characteristics (i.e., extent and concentrations) of the vadose zone COCs. Better definition of the COC characteristics will allow PRGs to be refined. The future refinement of PRGs will be agreed upon by the DOE, EPA, and the IDHW. Such a refinement will increase the three agencies' confidence that remedial action objectives can be met and maintained. It should be noted that PRGs for the OCVZ operable unit cannot be identified as discrete COC concentrations in the vadose zone.

Alternatives designed to achieve the remedial action objectives were assembled using combinations of the following general response actions.

- Institutional Controls—includes soil vapor and groundwater monitoring. Monitoring is effective for observing changes in vadose zone as well as groundwater contaminant concentrations and in identifying imminent hazards.

- Containment—only option for containment that can be implemented for the OCVZ is capping. A cap over the SDA may effectively prevent water from reaching the source pits and contributing to leaching of contaminants; thereby, minimizing the migration of contaminants to the environment. A cap would minimize migration of contaminants to the atmosphere at the surface of the SDA.

- Vapor Extraction—includes methods to extract vapor from the various regions of the vadose zone beneath the RWMC.

- In-Situ Treatment of Vapors—only reasonable option for in-situ treatment is bioremediation.

- Ex-Situ Treatment of Vapors—includes several options for biological, physical, thermal, and chemical treatment of vapors recovered from the vadose zone. Ex-situ treatment would attempt to reduce the toxicity, mobility, and volume of recovered contaminants.

## 7.2 Summary of Alternatives

In accordance with Section 121 of CERCLA, the Feasibility Study (FS) identified alternatives that (a) achieve the stated remedial action objectives, (b) provide overall protection of human health and the environment, (c) meet ARARs, and (d) are cost-effective.

The alternatives evaluated in the FS for OCVZ were Alternative 0—No Action; Alternative 1—Containment of Vadose Zone Vapors by Capping; Alternative 2—Extraction/ Treatment by Vapor Vacuum Extraction (VVE); Alternative 3—Extraction/Treatment by VVE with Vaporization Enhancement; and Alternative 4—In Situ Bioremediation. Alternatives 3 and 4 propose to use a catalytic oxidation unit to treat vapor. This technology is fairly new and may be substituted with other technologies such as carbon adsorption, biological treatment, ultraviolet treatment, etc. if implementation of the catalytic oxidation system proves to be ineffective or difficult due to site-specific circumstances.Although Alternative 4 was developed, it was not analyzed in detail with the other alternatives since it was decided early in the FS process that in situ bioremediation would be ineffective as well as very difficult to implement in the fractured basalt region beneath the RWMC. Descriptions of Alternatives 0 through 3 are provided in the following sections.

Substantive action-specific ARARs are identified for Alternatives 1-3. These ARARs, are listed in Table 9. Note that there are no action-specific ARARs for the No Action Alternative. The majority of ARARs focus on the management of materials and waste, including the regulation of air emissions from vapor treatment and remediation activities at the OCVZ operable unit. Specific requirements are:

- Characterization of hazardous wastes that may be generated from remediation activities
- Control of emissions from vapor treatment and recovery systems
- Measures to control fugitive dust from well drilling and earth moving.

No chemical-specific ARARs are identified for the considered alternatives. Regulations have not been promulgated specific to soil cleanup levels for vapor-phase contaminants. Also, no location-specific ARARs are identified as there are no known threatened and endangered species, wetlands, rivers, or floodplains located in the area of potential remedial activities under the considered alternatives.

Conservative calculations of organics in or contacting equipment demonstrate that concentrations by weight of hazardous air pollutants are well below the threshold criteria of applicability for the National Emission Standards for Hazardous Air Pollutants (NESHAP) program involving equipment leaks (40 CFR 61.240).

## 7.3 Alternative 0—No Action

Under this alternative, no attempt would be made to contain, treat in place, or extract and treat the organic contaminants present within the vadose zone. Instead, only long-term groundwater and soil vapor monitoring would be implemented. Groundwater monitoring is necessary to detect contaminant concentrations in the SRPA. Soil vapor monitoring is necessary to track the migration of contaminant vapors in the vadose zone. Changes in contaminant concentrations in groundwater and soil vapor would be evaluated to determine whether measures must be taken to minimize potential risks to public health and the environment. It was assumed that monitoring would continue for a period of 30 years under the No Action Alternative. This alternative was a "baseline" case against which the other alternatives were compared.

There are no ARARs identified for the No Action Alternative. Net present value costs for implementing groundwater and soil vapor monitoring under this alternative for the next 30 years are estimated to be $4.1 million.

**Table 9.** Summary of ARARs and TBC criteria for OCVZ alternatives.

| Statute | Regulation | Alternative 0 no action | Alternative 1 containment | Alternative 2 extraction/ treatment by VVE | Alternative 3 extraction/treatment by VVE with enhancement |
|---|---|---|---|---|---|
| RCRA | IDAPA § 16.01.050.5005, (40 CFR 261.10, 261.20-261.24) "Idaho Rules, Regulations and Standards for Hazardous Waste" | Not ARAR | Not ARAR | R/Yes | R/Yes |
| | 40 CFR 264.600 Subpart X, Miscellaneous Units | Not ARAR | Not ARAR | R/Yes | R/Yes |
| Clean Air Act | 40 CFR 61.92, "National Emission Standards for Radionuclide Emission from DOE Facilities" | Not ARAR | Not ARAR | A/Yes | A/Yes |
| | IDAPA §16.01.01.577, "Ambient Air Quality Standards for Specific Air Pollutants" | Not ARAR | Not ARAR | A/Yes | A/Yes |
| Idaho Toxic Air Pollutants Non-Carcinogenic Increments | IDAPA §16.01.015.85 | Not ARAR | Not ARAR | A/Yes | A/Yes |
| Idaho Toxic Air Pollutants Carcinogenic Increments | IDAPA § 16.01.015.86 | Not ARAR | Not ARAR | A/Yes | A/Yes |

**Table 9.** (continued).

| Statute | Regulation | Alternative 0 no action | Alternative 1 containment | Alternative 2 extraction/ treatment by VVE | Alternative 3 extraction/treatment by VVE with enhancement |
|---|---|---|---|---|---|
| Idaho Rules for Control of Fugitive Dust | IDAPA § 16.01.01.651 | Not ARAR | A/Yes | A/Yes | A/Yes |
| Idaho Demonstration of Preconstruction Compliance with Toxic Standards | IDAPA § 16.01.01.210.10 | Not ARAR | Not ARAR | R/Yes | R/Yes |
| DOE Order | DOE 5820.2A, "Radioactive Waste Management" | TBC | TBC | TBC | TBC |

A = Applicable

R = Relevant and Appropriate

TBC = To Be Considered.

## 7.4 Alternative 1—Containment of Vadose Zone Vapors by Capping

Alternative 1 consists of the installation of a cap over the SDA to minimize infiltration of rainwater, surface water, and snowmelt into the subsurface. Capping would reduce the amount of infiltrating moisture that reaches the waste buried in the SDA and contributes to downward migration of organic contaminants in the vadose zone. Capping is the systematic covering of an area with layers of soil, clay, and/or synthetic material that would be used, in this case, to provide a relatively impermeable barrier to surface water. Typical applications of capping are municipal landfills where contaminated water (i.e., leachate) is formed via infiltrating surface water. A cap of the SDA would consist of three layers of earthen fill over the entire 88-acre surface of the SDA.

Under Alternative 1, removal and treatment of organic contaminants would not occur. By minimizing the infiltration of water, capping would decrease the contact of water with organic contaminants at shallow depths directly beneath the disposal area; thus, migration of organic contaminants dissolved in infiltrating moisture would be reduced. However, even with capping, contaminants would continue to migrate both vertically and laterally in the vadose zone, primarily in the vapor phase.

The only ARAR identified for this alternative is Idaho Rules for Control of Fugitive Dust (IDAPA § 16.01.01.651). This ARAR would be met during the construction of a cap through appropriate engineering controls to minimize dust generation.

The net present value cost of Alternative 1 is estimated to be $43.3 million, including a nine million dollar contingency to cover unanticipated costs associated with capping materials acquisition. It is expected that it would take no more than 20 workers five years to construct the cap. As such, there are no significant socio-economic impacts associated with this alternative. Periodic maintenance of the cap would be needed to maintain its integrity. In addition, soil vapor and groundwater monitoring would be conducted to monitor the migration of organic contaminants in the vadose zone and SRPA.

## 7.5 Alternative 2—Extraction/Treatment by VVE

Alternative 2 would use VVE to remove organic vapors from the vadose zone. Extracted vapors would subsequently be treated at the surface. This alternative would utilize the existing VVE extraction well and several additional extraction wells which would be located in areas of the SDA known to have significant levels of organic vapors in the vadose zone. The existing VVE system was installed to determine the viability of VVE as a technology for the recovery and treatment of the vadose zone contaminants. The system consists of one vapor extraction well, a blower, and a carbon adsorption vapor treatment system. The extraction well is configured to draw vapors at a flowrate of approximately 200 cubic feet per minute from the 110-foot sedimentary interbed. This configuration recovers vapor organic contaminants from above and below the interbed. Figure 10 shows a conceptual cross-sectional view of the existing VVE system with geological features of the vadose zone and a conceptual representation of the vapor contaminant plume included.

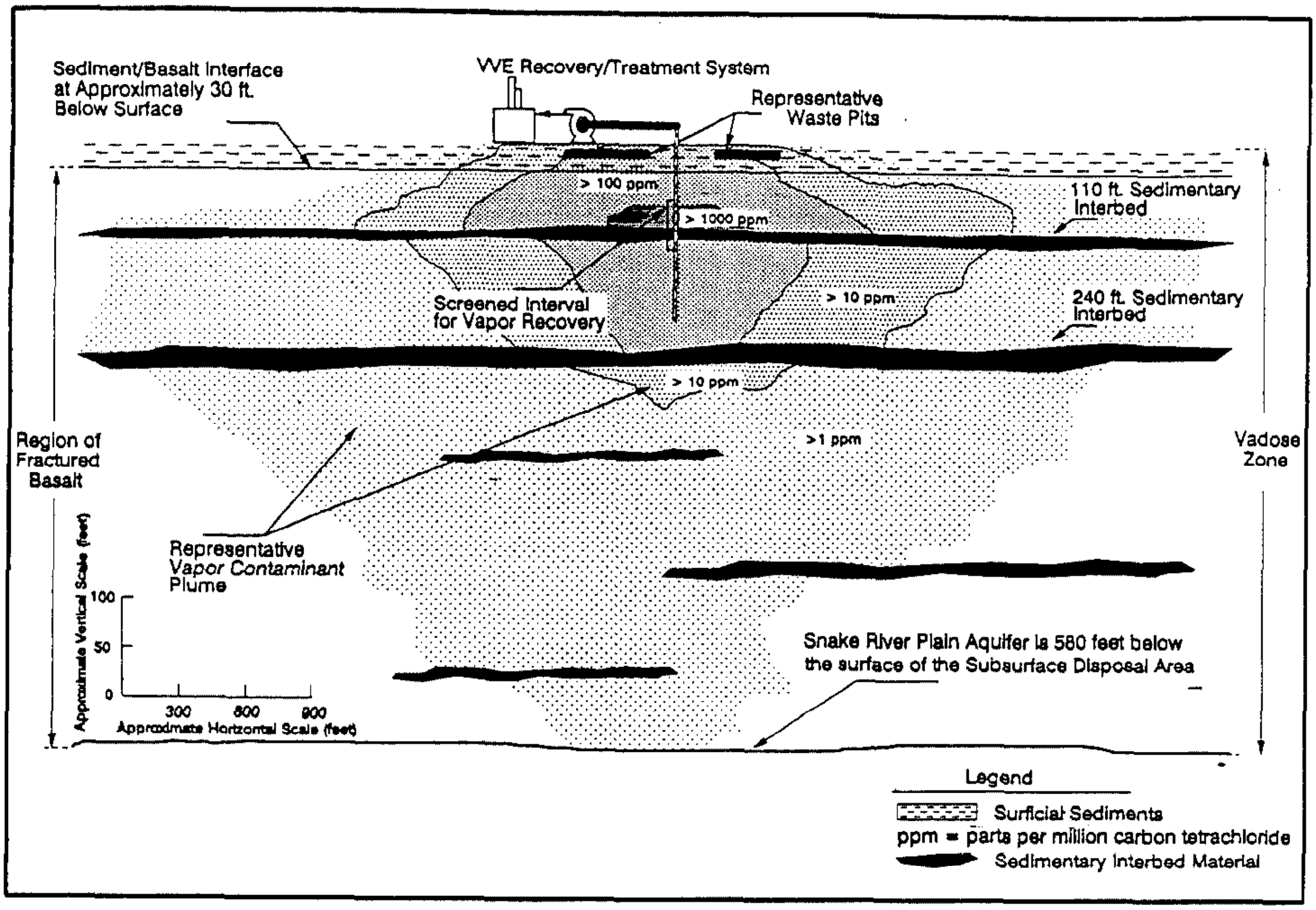


**Figure 10.** Schematic cross section of VVE system showing approximate extent of vapor plume and vapor extraction well.

Under a phased approach to Alternative 2, the existing VVE system would be augmented with additional vapor extraction wells, monitoring wells, and vapor treatment equipment. The first phase would include the installation of five additional vapor extraction wells (see Figure 11) to augment the contaminant recovery capability of the existing vapor extraction well. Additional vapor treatment units and vapor monitoring wells would support these five wells. Subsequent phases may also include more vapor extraction wells, monitoring wells, passive venting wells, and vapor treatment units. In order to clarify the range of cost for Alternative 2, it was assumed that a second phase would involve the installation of four additional vapor extraction wells and accompanying support equipment, for a total of 10 wells (including those installed under the first phase). A maximum number of fourteen vapor extraction wells and accompanying support equipment would be expected under a third and final phase of Alternative 2. A more detailed discussion on the use of phases under Alternative 2 is included below. In addition to contaminant recovery and treatment, Alternative 2 would include long-term soil vapor and groundwater monitoring.

Each vapor extraction well would be linked to a catalytic oxidation unit or equivalent vapor treatment system. Such a treatment system could typically achieve a sufficient contaminant destruction efficiency for the extracted vapors, and be capable of maintaining an airflow that would

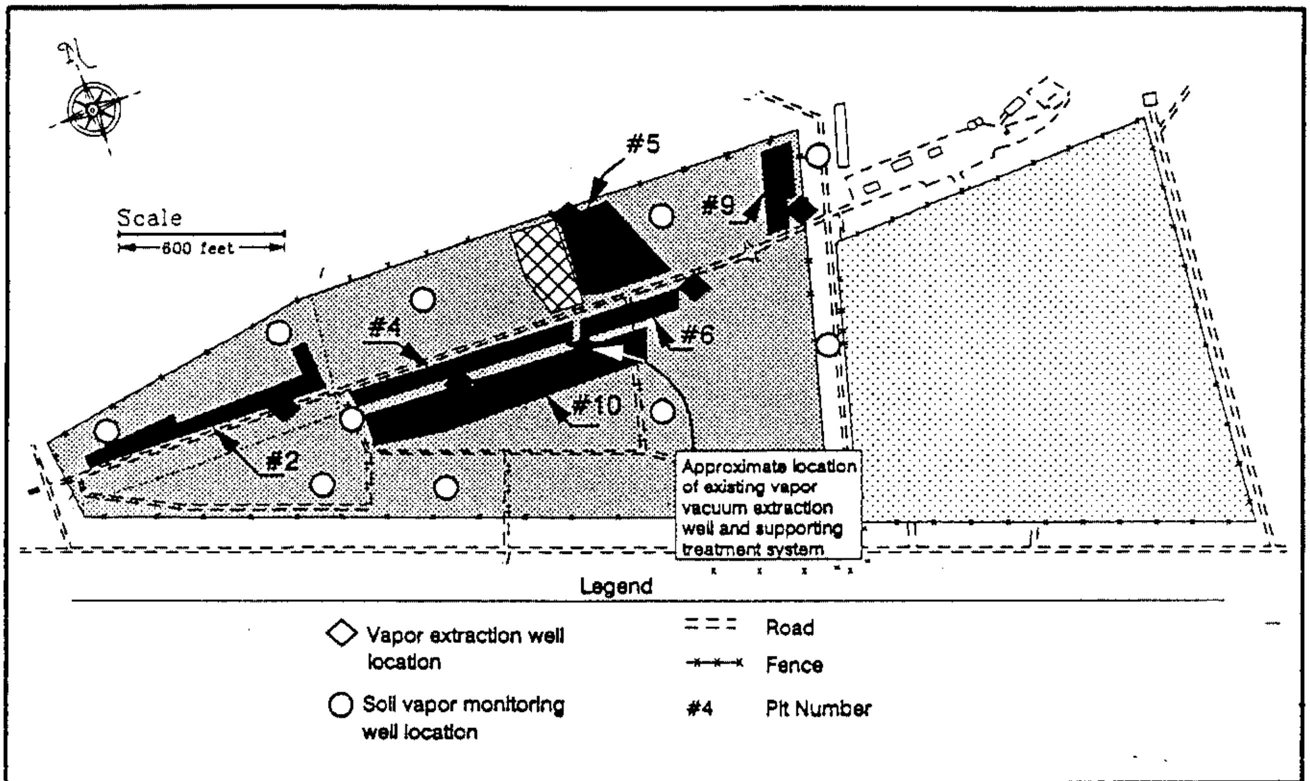


**Figure 11.** Alternative 2 Phase I vapor extraction/monitoring wells.

range between 125 and 150 cfm. Catalytic oxidation is basically a thermal process that is capable of converting chlorinated hydrocarbons (such as the $CCl_4$, TCE, PCE, 1,1,1-TCA, and chloroform present at OCVZ) into carbon dioxide, water, and hydrochloric acid (HCl) gas. It accomplishes thermal destruction at a relatively low temperature in the presence of a catalyst. It is expected that under a possible third phase of this alternative, which would entail the most extensive use of catalytic oxidation, the HCl emission would be below applicable air discharge requirements, even without scrubbing for acid gas removal. Overall, catalytic oxidation was favored as the representative process option for air treatment because of its proven ability to destroy the types of contaminants present at OCVZ, its availability in modular compact units that could be placed adjacent to each vapor extraction well, and its relatively low operation and maintenance costs. Potentially, one catalytic oxidation unit would be dedicated to each extraction well due to the large distances between wells. The units would require fuel such as propane to maintain the contaminant oxidation process.

The FS considered other vapor treatment technologies such as biological treatment, ultraviolet treatment, and carbon adsorption. Based on available performance data, biological and ultraviolet treatment would require further development in order to be a viable vapor treatment option for the large-scale application that would be required under Alternative 2. Carbon adsorption has already been demonstrated as a viable vapor treatment option during the OCVZ treatability studies; however, difficulties associated with the handling and regeneration of contaminant-saturated carbon must be resolved in order to utilize this technology for large-scale vapor treatment at the RWMC. Further investigation of available air treatment technologies that would be most appropriate to support VVE at OU 7-08 would continue through the design of Alternative 2.

Each of the ARARs identified for this alternative would be met through appropriate engineering controls such as vapor treatment. Through the use of catalytic oxidation for vapor treatment, it is expected that no residual treatment wastes would be generated under Alternative 2. Net present value costs for implementing this alternative range from $12.9 to $32.4 million. The cost range corresponds to first phase operations through third phase operations for a period of two years to six years, respectively. It has been assumed that cleanup goals would be attained at some point in the zero to six year timeframe. The costs also include an assumption of thirty years for soil vapor and groundwater monitoring. It is estimated that a maximum of ten workers would be required to complete this alternative. As such, there would be no significant socio-economic impacts associated with this alternative.

**Phases of Alternative 2**

The potential progression of Alternative 2 to a second and third phase would be dependent on the ability of the vapor extraction system to achieve the remedial action objectives, i.e., ensure that risks to future groundwater users are within acceptable guidelines and that future contaminant concentrations in the aquifer remain below Federal and state safe drinking water standards. The performance of Alternative 2 would be reviewed on a two year (24 month) cycle, with each phase of operation under the alternative expected to last at least two years. The actual duration of each phase would be dependent on elements such as equipment procurement and installation that may be involved with each transition; however, the following description of the review cycle assumes that transitions would occur in a timely fashion every 24 months.

The first review would commence after 18 months of operation under the first phase. Data accumulated over these 18 months would be analyzed and a decision made by DOE, EPA, and the IDHW as to what would comprise the second phase of Alternative 2 (if a second phase is necessary to attain remedial action objectives). Alternative 2 would continue under first phase operations up to 24 months, at which time, after the data analysis period, a transition to the second phase would occur. Data analyzed would be relevant to the attainment of remedial action objectives (e.g., contaminant recovery rates, equilibrium contaminant concentrations in the vadose zone, etc.).

Considerable engineering judgement would be used in deciding what modifications to the first phase would be made to continue Alternative 2 into a second phase in order to achieve remedial action objectives. Potential options for continuing Alternative 2 into a second phase include: (1) continuing operation with no changes to the first phase of operation; (2) adding more vapor extraction wells; (3) extracting from different depths within existing extraction wells; (4) converting monitoring wells into extraction wells; and (5) adding and/or converting existing wells to passive venting wells. These options and others not currently identified may be carried out singly or in combinations, with the intent being to ensure that Alternative 2 achieves remedial action objectives.

The need for additional phases beyond a second phase would be evaluated using the same general approach as outlined above for the transition between the first and possible second phase. If a second phase is implemented, then the data evaluation and decision regarding a possible third phase would begin 18 months into the second phase (i.e., 42 months from the start of Alternative 2) with the third phase beginning, if necessary, approximately 48 months from the start of Alternative 2. Potential options for continuing Alternative 2 into a third phase would be similar to those listed above. This type of phased operation would continue through phases lasting 24 months each until remedial action objectives are achieved.

## 7.6 Alternative 3—Extraction/Treatment by VVE with Vaporization Enhancement

Alternative 3 would include VVE (as described for Alternative 2) as the primary contaminant recovery method with radio frequency heating to enhance the vaporization of organic contamination in the vadose zone. Radio frequency heating would target contaminants that have partitioned to the aqueous phase in the vadose zone (i.e., organic contaminants dissolved in soil moisture or perched water) or have adsorbed onto material in the sedimentary interbeds. Radio frequency heating would use strategically placed antennae in boreholes to raise the temperature in discrete areas of the subsurface. The increased temperature would induce volatilization of the organic contaminants. Volatilized contaminants would then be recovered by the VVE system. The temperature in the subsurface would be raised gradually to allow the VVE system to recover organic contaminants as they volatilize. The VVE system under Alternative 3 would include 14 vapor extraction wells and 14 boreholes installed to the 110-foot interbed to accommodate the insertion of the radio frequency heating antennae.

Each of the ARARs identified for this alternative would be met as discussed for Alternative 2. Net present value costs for implementing Alternative 3 are estimated to be $59.9 million. This cost is based on operation of a full network of VVE wells and no more than two radio frequency heating antennae operating at any given time over a period of six years. The costs include an assumption of thirty years for soil vapor and groundwater monitoring. It is estimated that no more than ten workers would be required to complete this alternative. As such, there are no significant socio-economic impacts associated with Alternative 3.

# 8. SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES

CERCLA guidance requires that each remedial alternative be compared according to nine evaluation criteria that have been developed to serve as a basis for conducting the detailed analyses of alternatives and for subsequently selecting an appropriate remedial action. The evaluation criteria are divided into three categories: (1) threshold criteria that relate directly to statutory findings and must be satisfied by each chosen alternative; (2) primary balancing criteria that include long- and short-term effectiveness, implementability, reduction of toxicity, mobility, and volume, and cost; and (3) modifying criteria that measure the acceptability of the alternatives to State agencies and the community. The following sections summarize the evaluation of the candidate remedial alternatives according to these criteria.

## 8.1 Threshold Criteria

The remedial alternatives were evaluated in relation to the threshold criteria: overall protection of human health and the environment and compliance with ARARs. The threshold criteria must be met by the remedial alternatives (except the No Action Alternative) for further consideration as potential remedies.

### 8.1.1 Overall Protection of Human Health and the Environment

This criterion addresses whether an alternative provides protection of human health and the environment and describes how risks posed through each exposure pathway are eliminated, reduced, or controlled through treatment, engineering controls, or institutional controls.

Alternatives 2 and 3, Extraction/Treatment by VVE and Extraction/Treatment by VVE with Vaporization Enhancement, respectively, satisfy the criterion of overall protection of human health and the environment. The alternatives accomplish this by recovering and treating organic vadose zone contaminants, thus, preventing unacceptable levels of contaminant migration to the SRPA and also potentially reducing the mass flow of contaminants to the surface soils and atmosphere above the RWMC.

Alternative 1, Containment of Vadose Zone Contaminants by Capping, also satisfies this criterion to the degree that it protects human health by potentially reducing the level of contaminant migration to the SRPA and by reducing the mass flow of contaminants to the atmosphere at the surface of the RWMC. It is not clear, however, how much of a reduction in the amount of organic contaminants reaching the SRPA would occur under this alternative. This uncertainty stems in part from the potential migration of contaminants at greater depths that may still be affected by water infiltrating from areas outside of the SDA. Capping would not affect organic contaminants in the vadose zone that have migrated laterally beyond the boundary of the SDA. Although not considered an ARAR for this OU, it is likely that contaminant concentrations in the aquifer would exceed MCLs in the future under this alternative.

Overall, each of the alternatives, with the exception of Alternative 0, No Action, would result in a lifetime excess cancer risk within the acceptable range of $1 \times 10^{-4}$ to $1 \times 10^{-6}$. Also, hazard indices associated with the COCs would be reduced to acceptable levels. Alternative 1 would accomplish this by reducing the migration of contaminants to the SRPA through a reduction in moisture infiltration at the surface of the SDA. Alternatives 2 and 3 would accomplish this by recovering and treating the most significant levels of vadose zone contaminants present. Although there is some uncertainty in the modeling results, it is believed that the No Action Alternative would not satisfy the criterion of Overall Protection of Health and the Environment.

### 8.1.2 Compliance with ARARs

CERCLA, as amended by SARA, requires that remedial actions for Superfund sites comply with identified substantive applicable requirements identified under Federal and state laws. Remedial actions must also comply with the requirements of laws and regulations that are not directly applicable but are relevant and appropriate, in other words, requirements that pertain to situations sufficiently similar to those encountered at a Superfund site so that their use is well suited to the site. Combined, these are referred to as ARARs. State ARARs are limited to those requirements that are (a) promulgated, (b) uniformly applied, and (c) are more stringent than Federal requirements. Compliance with ARARs requires evaluation of the remedial alternatives for compliance with chemical, location, and action-specific requirements.

Three of the remedial alternatives considered for OCVZ comply with the identified ARARs through engineering controls and operating procedures. ARARs are not identified for the No Action

Alternative since no treatment or containment activities are proposed with this alternative. A summary of the ARAR analysis is presented in the Summary of Alternatives section and listed in Table 9. The action-specific ARARs focus on management of materials and waste and the regulation of air emissions that may result from remediation activities at the OCVZ operable unit—no chemical- and location-specific ARARs are identified. The specific substantive requirements of the action-specific ARARs are:

- Identification of hazardous wastes that may be generated from remediation activities
- Control of emissions from vapor treatment and recovery systems
- Measures to reduce potential fugitive dust from well drilling and capping activities.

## 8.2 Balancing Criteria

Each alternative that satisfies the threshold criteria is evaluated against each of the five balancing criteria. The balancing criteria are used in refining the selection of the candidate alternatives for the site. The five balancing criteria are: (1) long-term effectiveness and permanence; (2) reduction of toxicity, mobility, or volume through treatment; (3) short-term effectiveness; (4) implementability; and (5) cost. Each criterion is further explained in the following sections.

### 8.2.1 Long-Term Effectiveness and Permanence

This criterion evaluates the long-term effectiveness of alternatives in maintaining protection of human health and the environment.

Alternatives 2 and 3 provide the greatest level of long-term effectiveness and permanence by targeting for recovery and treatment vapor contaminants present throughout the upper portion of the vadose zone. Alternative 2 provides a slightly lower level of long-term effectiveness than Alternative 3 because it does not incorporate an option to enhance contaminant recovery. In other words, Alternative 2 has a slightly greater potential than Alternative 3 to leave untreated contaminants in the vadose zone, although this potential is considered to be fairly small because the RI did not indicate that there was a significant amount of the COCs partitioned to perched groundwater and/or the sedimentary interbeds; i.e., regions of the vadose zone that would be targeted for enhanced recovery if contaminants were prevalent there. A degree of risk would remain with Alternatives 2 and 3 because it is not possible to remove and treat all of the vadose zone organic contaminants.

Alternative 1 also provides long-term effectiveness and permanence, but to a lesser degree than Alternatives 2 and 3 due to uncertainties associated with its performance and due to its lack of contaminant removal and treatment. That is, Alternative 1 is a less reliable remedy, and the degree of risk remaining after it is implemented would be greater than the risk remaining under Alternatives 2 or 3.

The No Action Alternative provides the lowest level of long-term effectiveness and permanence as it provides no recovery or measures to reduce the migration of contaminants through the vadose zone toward the SRPA.

### 8.2.2 Reduction of Toxicity, Mobility, or Volume through Treatment

This criterion addresses the statutory preference for selecting remedial actions that employ treatment technologies, which permanently reduce toxicity, mobility, or volume of the hazardous substances as their principal element.

Alternatives 2 and 3 each provide a reduction in the volume of organic contaminants present in the vadose zone. The reduction in volume is accomplished by removing vapors with a VVE system and treating the removed organic contaminants. Alternative 3 offers an advantage over Alternative 2 because it has a greater potential to achieve the necessary organic contaminant removal more effectively by enhancing the recovery of the VVE system through heating of areas of the vadose zone. The overall improvement in contaminant recovery afforded by Alternative 3 over Alternative 2 cannot be fully evaluated at this time. It is reasonable to assume, however, that some benefit to contaminant recovery would be realized.

Alternative 1 does not provide any treatment of the contaminants present; however, it does limit the mobility of contaminants present in the vadose zone by minimizing the infiltration rate directly below the SDA. The No Action Alternative provides no reduction in toxicity, mobility, or volume of the contaminants present in the vadose zone.

### 8.2.3 Short-Term Effectiveness

Short-term effectiveness addresses the effects of each alternative during its construction and implementation phase until remedial action objectives are achieved. Under this criterion, the alternatives are evaluated with respect to their impacts on human health and the environment during implementation of the alternative.

In general, alternatives requiring the least amount of construction and/or operation and handling of equipment, residual wastes, etc. rank the highest in terms of short-term effectiveness. As such, the No Action Alternative ranks high under this criterion because it requires no additional on-site activities and does not result in additional acute hazards to the public or the environment.

Alternative 2 ranks slightly higher than Alternative 3 because it is simpler in terms of the amount of equipment and operations personnel involved. Each of these alternatives has a slight potential for worker risks through physical hazards associated with borehole installation and operation/maintenance of the contaminant treatment system. Alternative 3 has additional worker risk associated with the operation of the radio frequency heating system (e.g., electrical and heating hazards). There would be no significant increase in potential risks to the public under any of these treatment alternatives. This is mainly due to the fact that the bulk of the contaminants would remain isolated from the surface environment in their present form within the vadose zone beneath the RWMC. Those contaminants brought to the surface would be controlled by a surface-based vapor treatment system designed to destroy contaminants on-site. The operation of this treatment system would be monitored to ensure that releases of contaminants to the environment do not exceed acceptable air emission levels.

Alternative 1 ranks the lowest of the considered alternatives under this criterion. This alternative would require a significant level of construction activities associated with the installation of a cap over the SDA. Potential risks to workers, including risks associated with the transportation of needed construction materials to the RWMC, outweigh all other elements under short-term effectiveness.

### 8.2.4 Implementability

The implementability criterion has the following three factors requiring evaluation: (1) technical feasibility, (2) administrative feasibility, and (3) the availability of services and materials. Technical feasibility requires an evaluation of the ability to construct and operate the technology, the reliability of the technology, the ease of undertaking additional remedial action (if necessary), and monitoring considerations. Administrative feasibility generally includes an evaluation of the coordination of actions between agencies, planning, and personnel training. In terms of services and materials, an evaluation of the following availability factors is required: necessary equipment and specialists, prospective technologies, and cover materials.

Each of the alternatives retained for detailed evaluation is implementable. Alternative 3 ranks lower than Alternatives 2 or 0 for implementability because of its slightly greater complexity in equipment procurement, installation, and operation. Alternative 1 ranks lower than all of the alternatives because of potential difficulties associated with construction of the cap, including: coordination with potential cleanup actions for other OUs at the RWMC (this is an administrative difficulty) and procurement of extensive amounts of materials.

Long-term monitoring under these alternatives would detect any serious failure in recovering or containing vadose zone contaminants, allowing appropriate steps to be taken to preclude significant exposures to contaminated groundwater from the SRPA. Each of the alternatives ranks equally with regard to the implementability of a long-term monitoring program.

### 8.2.5 Cost

In evaluating project costs, an estimation of the net present value of capital costs and operation and maintenance costs is required. In accordance with CERCLA guidance, the costs presented are estimates (i.e., -30% to +50%). Actual costs could vary based on the final design and detailed cost itemization. The cost estimates for the alternatives analyzed for OCVZ are presented in Table 10. Note that the costs presented for Alternative 2 are provided for each of the three phases of operation that may be implemented. The total cost of each phase is cumulative in that it includes costs from each prior phase.

## 8.3 Modifying Criteria

The modifying criteria are used in the final evaluation of remedial alternatives. The two modifying criteria are state and community acceptance. For both of these criteria, the factors that are considered include the elements of the alternatives that are supported, the elements of the alternatives that are not supported, and the elements of the alternatives that have strong opposition.

**Table 10.** OCVZ alternative cost estimates (net present value).

| Cost element | Alternative 0 (no action) | Alternative 1 | Alternative 2 Phase I | Alternative 2 Phase II | Alternative 2 Phase III | Alternative 3 |
|---|---|---|---|---|---|---|
| Construction | 0 | 39,118,000 | 3,013,000 | 5,036,000 | 6,893,000 | 8,296,000 |
| Operation and Maintenance | 0 | 140,000 | 4,955,000 | 11,443,000 | 19,071,000 | 45,211,000 |
| Post-Closure Monitoring | 4,069,000 | 4,069,000 | 4,888,000 | 5,495,000 | 6,393,000 | 6,403,000 |
| Total | 4,069,000 | 43,330,000 | 12,860,000 | 21,970,000 | 32,360,000 | 59,910,000 |

### 8.3.1 State Acceptance

The IDHW concurs with the selected remedial alternative, Extraction/Treatment by VVE. The IDHW has been involved in the development and review of the RI/FS report, the Proposed Plan, this ROD, and other project activities such as public meetings.

### 8.3.2 Community Acceptance

This assessment evaluates the general community response to the proposed alternatives presented in the Proposed Plan. Specific comments are responded to in the attached Responsiveness Summary portion of this document.

## 9. SELECTED REMEDY

Based upon consideration of the requirements of CERCLA, the detailed analysis of alternatives, and public comments, DOE-ID, EPA, and IDHW have selected Alternative 2—Extraction/Treatment by VVE as the most appropriate remedy for OCVZ, OU 7-08 at the RWMC. In terms of public risk, fate and transport modeling indicates that there is a potential unacceptable risk to future residential receptors using groundwater beginning at about the year 2062. The modeling also indicated that Federal and state drinking water standards would be exceeded for $CCl_4$, TCE, and PCE due to the migration of these contaminants to the SRPA. Drinking water standards could potentially be exceeded for these contaminants beginning in about 1997 and extending for several hundred years. The exposure of hypothetical future residents to contaminants in groundwater led to the selection of Alternative 2. The extraction of the most significant concentrations of contaminants from the vadose zone with subsequent treatment of the contaminants will reduce the amount of contaminants that will migrate to the SRPA. Extraction/treatment by VVE is believed to be the best alternative for minimizing public risk and providing long-term protection of the SRPA. The success of the VVE treatability study conducted at the RWMC supports the selected remedy. The phased approach of the selected remedy provides a high level of assurance that remedial action objectives will be achieved in a cost-effective manner.

## 9.1 Extraction/Treatment by VVE Description

The major components of Alternative 2—Extraction/Treatment by VVE include vapor extraction, vapor treatment, and institutional controls such as long-term subsurface vapor and groundwater monitoring. The selected alternative is believed to provide the best balance of trade-offs among the alternatives with respect to the nine CERCLA evaluation criteria. DOE-ID, EPA, and IDHW believe the preferred alternative is protective of human health and the environment, complies with applicable federal and state regulations, and is cost-effective.

Alternative 2 focuses on the extraction of vapor-phase organic contaminants from the vadose zone beneath the RWMC through the use of VVE. Alternative 2 will commence with extraction via the existing vapor extraction well that supported VVE tests and five additional vapor extraction wells located to recover the most significant concentrations of vapor-phase organic contaminants from the vadose zone (see Figure 11). This arrangement of six vapor extraction wells is considered the first phase of Alternative 2. Extracted vapors will be treated at the surface to destroy the organic contaminants. Vapor monitoring wells will also be installed to monitor changes in contaminant concentrations in the vadose zone as a result of the vapor extraction operations. If, following an evaluation of the implemented remedy (approximately two years after implementation), the agencies conclude that data from modeling and monitoring show that vadose zone contamination is not being sufficiently reduced to prevent Federal and state MCLs from being significantly exceeded in the aquifer (see Section 9.2), additional phases of Alternative 2 may be proposed. It is expected that there would be no need for Alternative 2 to be expanded beyond a third phase of operation. A third phase could entail the operation of up to approximately fourteen vapor extraction wells (assumed for cost estimating purposes) located at and within the vicinity of the RWMC. A detailed description of the use of phases under Alternative 2 is provided in Section 7.5 of this ROD.

In addition to the extraction and treatment of the vadose zone contaminants, Alternative 2 will include long-term groundwater and soil vapor monitoring to confirm the ability of the vapor extraction system to prevent contaminants from migrating to the SRPA at levels that would result in unacceptable groundwater contaminant concentrations. Such monitoring will continue after remediation to verify that organic contaminant concentrations in the vadose zone and groundwater remain below acceptable levels.

## 9.2 Remediation Goals

The purpose of Alternative 2 is to reduce the concentration of organic contaminants presently in the vadose zone and, consequently, the amount of contaminants reaching the SRPA in the future. This reduction in organic contaminants will ensure that risks to future groundwater users are within acceptable guidelines and that future contaminant concentrations in the aquifer remain below Federal and state MCLs.

The alternative will be designed so that the remedial system achieves the remedial action objectives and associated PRGs. The PRGs have been estimated through fate and transport modeling as vadose zone vapor contaminant concentrations that *will not* result in future groundwater contaminant concentrations exceeding Federal and state MCLs. The PRG for the contaminant present in the most significant concentrations, $CCl_4$, is approximately 30 to 200 ppmv, depending on the location within the vadose zone. The other vadose zone contaminants have similar cleanup goals. Contaminants remaining in the vadose zone after implementing Alternative 2 will not result in unacceptable future risks to human health and the environment, nor will they result in a violation of Federal and state MCLs.

The PRG range of 30 to 200 ppmv for $CCl_4$ is strictly an estimate of the $CCl_4$ concentration, which is based on information available to date, that will enable the remedial action objectives to be achieved. It should be noted that PRGs for the OCVZ operable unit cannot be identified as discrete COC concentrations in the vadose zone because of: (1) the complex relationship between vadose zone COC concentrations and future groundwater COC concentrations, and (2) the lack of regulatory driven standards for the COCs in vadose zone soils. During the implementation of the selected remedy, information will be obtained that will allow concentrations of the vadose zone COCs to be further defined. A better definition of the COC concentrations will allow PRGs to be refined, i.e., the targeted concentrations at various locations throughout the contaminated region of the vadose zone could be identified more specifically, and attainment of remedial action objectives more readily determined. The future refinement of PRGs will be agreed upon by the DOE, EPA, and IDHW. Such a refinement will increase the three agencies' confidence that remedial action objectives, which *will not* change, can be met and maintained.

Flexibility in cleanup goals for the OCVZ is essential for the selected remedial alternative given the level of additional information on the OCVZ that is expected to be obtained during each of the potential phases of Alternative 2. The cleanup goals will require a significant amount of re-evaluation during the course of remedial action. A re-evaluation will be focused primarily on fate and transport modeling, which will take into account information gathered while carrying out the selected remedy as well as any future cleanup actions that may take place with the pits and trenches at the SDA. Changes in fate and transport modeling will likely have an impact on the PRGs for the OCVZ.

For those remedial actions that allow hazardous substances to remain on-site, Section 121 (c) of CERCLA requires that a review be conducted of the remedy within five years after initiation of the remedial action and at least once every five years thereafter. The purpose of this review is to evaluate the remedy's performance—to ensure that the remedy has achieved, or will achieve, the remedial action objectives set forth in the ROD and that it continues to be protective of human health and the environment. During implementation of Alternative 2 at OCVZ, the remedy's performance will be reviewed on a two year (24 month) cycle, with each phase of operation under Alternative 2 expected to last at least two years. The review cycle is detailed under the description of the phases of Alternative 2, page 46. Per CERCLA, a review of the site will be conducted five years after extraction/treatment operations are discontinued.

## 9.3 Estimated Costs for the Selected Remedy

A summary of cost for each of the alternatives was presented in Table 10. A more detailed cost breakdown for each of the three potential phases of Alternative 2 are provided in Table 11. These costs were annualized where appropriate (e.g., long-term monitoring costs) and summarized in net present value (1993) using a five percent annual discount rate.

**Table 11.** OCVZ selected remedy cost summary.[a]

| Cost Elements | Alternative 2 Vapor Vacuum Extraction (VVE) Phase 1 | Phase 2 | Phase 3 |
|---|---|---|---|
| **Construction** | | | |
| VVE/Monitoring Wells | $558,800 | $967,371 | $1,337,117 |
| Field Personnel | $76,200 | $131,337 | $181,235 |
| Site Improvements | $11,025 | $21,003 | $40,291 |
| Treatment System/Discharge Monitor | $583,473 | $937,257 | $1,257,423 |
| Additional Direct Costs | $132,691 | $219,740 | $299,603 |
| Project Supervision & Engineering | $955,532 | $1,597,506 | $2,186,414 |
| Contingency (30 %) | $695,316 | $1,162,264 | $1,590,624 |
| Construction Subtotal | $3,013,037 | $5,036,479 | $6,892,706 |
| **Operations and Maintenance** | | | |
| Technical Support | $75,253 | $211,765 | $373,403 |
| Operating/Maintenance Labor | $144,320 | $295,623 | $451,363 |
| Materials & Equipment | $132,735 | $340,475 | $608,127 |
| Vapor Sampling | $1,805,660 | $4,126,717 | $6,851,732 |
| Additional Direct Costs | $83,919 | $203,022 | $344,740 |
| Project Supervision & Engineering | $1,569,320 | $3,624,321 | $6,040,555 |
| Contingency (30 %) | $1,143,363 | $2,640,578 | $4,400,977 |
| O&M Subtotal | $4,954,569 | $11,442,502 | $19,070,897 |
| **Post Closure Monitoring** | | | |
| Well Closure/Demolition | $7,673 | $11,227 | $14,241 |
| Vapor & Groundwater Monitoring | $3,128,250 | $3,390,684 | $3,943,952 |
| Project Management | $625,644 | $747,643 | $869,642 |
| Contingency (30 %) | $1,126,171 | $1,345,763 | $1,565,355 |
| Post Closure Monitoring Subtotal | $4,887,738 | $5,495,316 | $6,393,189 |
| **TOTAL (b)** | **$12,860,000** | **$21,970,000** | **$32,360,000** |

(a) All costs represent 1994 dollars at a 5% discount rate.
(b) Total costs have been rounded to the nearest $10,000 and are cumulative for Alternative 2.

# 10. STATUTORY DETERMINATIONS

Remedy selection is based on CERCLA, as amended by SARA, and the regulations contained in the NCP. All remedies must meet the threshold criteria established in the NCP: protection of human health and the environment and compliance with ARARs. CERCLA also requires that the remedy use permanent solutions and alternative treatment technologies to the maximum extent practicable and that the implemented action must be cost-effective. Finally, the statute includes a preference for remedies that employ treatment that permanently and significantly reduce the volume, toxicity, or mobility of hazardous wastes as their principal element. The following sections discuss how the remedy meets these statutory requirements.

## 10.1 Protection of Human Health and the Environment

As described in Section 9, the selected remedy satisfies the criterion of overall protection of human health and the environment by reducing the level of organic contamination in the vadose zone beneath and within the immediate vicinity of the RWMC and, consequently, reducing the risk associated with the future use of groundwater from the SRPA. The remedy will ensure that cumulative carcinogenic risk levels are maintained within the NCP risk range ($1 \times 10^{-4}$ to $1 \times 10^{-6}$), and the cumulative hazard index is maintained less than 1.

The selected remedy will extract and treat (i.e., destroy) the most significant concentrations of organic contaminants currently in the vadose zone. The remedy will include long-term groundwater and soil vapor monitoring to confirm the ability of the vapor extraction system to prevent unacceptable levels of contaminants from migrating to the SRPA. The agencies will be involved in reviewing the performance of the remedy as part of potential phase transitions expected to occur every two years after commencement (see description of Alternative 2 phases on page 46 as well as the description of remediation goals on page 54). Once remedial action objectives are achieved and maintained and the remedy is discontinued, the agencies will review the OCVZ after a period of five years to ensure that human health and the environment are being protected. No unacceptable short term risks will be associated with this remedy.

## 10.2 Compliance with ARARs

The selected remedy of Extraction/Treatment by VVE will be designed to meet all substantive requirements of the identified Federal and state ARARs. The ARARs that will be achieved by the selected alternative follow.

### 10.2.1 Chemical-Specific ARARs

No chemical-specific ARARs are identified for the selected remedy. Soil-specific regulatory standards have not been promulgated by EPA or the State of Idaho.

### 10.2.2 Action-Specific ARARs

The action-specific ARARs identified for the selected remedy focus on the management of materials and waste and the regulation of air emissions that may result from any remediation activities at OCVZ. Regulations that focus on hazardous contaminants include:

**RCRA**

- IDAPA § 16.01.050.5005 (40 CFR 261.10, 261.20 through 261.24), "Idaho Rules, Regulations, and Standards for Hazardous Waste" identification and characterization. (Relevant and Appropriate)

  If there are residuals that are hazardous, then Idaho's standards for generators of hazardous waste (IDAPA § 16.01.050.06) will be complied with throughout the implementation of this alternative.

- 40 CFR 264.600 et seq involving prevention of releases from hazardous waste constituents in miscellaneous units. The overall intent of this regulation is to provide protection of human health and the environment. (Relevant and Appropriate)

Governing regulations that focus on air quality include:

**Clean Air Act**

- 40 CFR 61.92, "National Emission Standards for Radionuclide Emission from DOE Facilities" (Applicable).
- IDAPA § 16.01.01.577, "Ambient Air Quality Standards for Specific Air Pollutants" (Applicable).

**Idaho Toxic Air Pollutants for Non-carcinogenic and Carcinogenic Increments**

- IDAPA §16.01.015.85 and 16.01.015.86 for any source constructed after May 1, 1994 (Applicable).

**Idaho Rules for Control of Fugitive Dust**

- IDAPA §16.01.01.651 (Applicable).

**Idaho Demonstration of Preconstruction Compliance with Toxic Standards**

- IDAPA §16.01.01.210.10 (Relevant and Appropriate).

### 10.2.3 Location-Specific ARARs

No location-specific ARARs are identified for the selected remedy as there are no known threatened and endangered species, wetlands, rivers, or floodplains located in the area of remedial activities.

### 10.2.4 To-Be-Considered Guidance

In implementing the selected remedy, the agencies have agreed to consider DOE Order 5820.2A, "Radioactive Waste Management" as to-be-considered guidance. The guidance is not legally binding.

DOE Order 5820.2A establishes policy, guidelines, and minimum requirements for radioactive and mixed waste management. The policy establishes that radioactive and mixed waste generation, treatment, storage, transportation, and disposal operations comply with all applicable Federal, state and local requirements. Authorities within DOE who are responsible for policy implementation are identified.

## 10.3 Cost Effectiveness

Based on expected performance, the selected remedy has been determined to be cost-effective. This is evident when considering the cost of Alternative 1, Containment of Vadose Zone Vapors by Capping, which is estimated to be over three times the estimated costs of the selected remedy, yet there is a high level of uncertainty associated with the ability of capping to achieve remedial action objectives. Likewise, there is a high level of uncertainty in estimating the benefits to effectiveness that Alternative 3, Extraction/Treatment by VVE with Vaporization Enhancement, would have over the selected remedy. Alternative 3 has an estimated cost that is over four times that of the selected remedy.

## 10.4 Use of Permanent Solutions and Alternative Treatment Technologies to the Maximum Extent Practicable

The selected remedy utilizes permanent solutions to the maximum extent practicable for this site. The NCP prefers a permanent solution whenever possible. Because contamination at OCVZ is so extensive and the concentrations of contaminants decrease with distance from the SDA, the selected remedy focuses on the extraction and treatment of only the most concentrated areas of contamination. Those contaminants remaining in the vadose zone will not pose unacceptable risks to potential receptors. The selected remedy provides protection of human health and the environment by preventing unacceptable levels of organic vapors from migrating to the SRPA and the surface. Based on evaluation of the CERCLA remedial alternative criteria, and in particular the five balancing criteria, extraction/treatment by VVE will provide the best solution in terms of long- and short-term effectiveness, cost, and implementability.

## 10.5 Preference for Treatment as a Principal Element

Because the OCVZ investigation indicated that no action would lead to unacceptable levels of contaminants reaching the SRPA and that an attempt to contain the contaminants in the vadose zone above the aquifer would not provide reasonable assurance that the aquifer would be protected, extraction and treatment of the vadose zone contaminants was viewed as being the only alternative that would meet remedial action objectives for OCVZ. Extraction and treatment of OCVZ contaminants under the selected remedy includes destruction of the organic contaminant with a vapor treatment system (catalytic oxidation) at the surface. This type of treatment is irreversible because contaminants are converted to carbon dioxide, water, and HCl gas, which will be discharged at acceptable levels to the atmosphere.

# 11. DOCUMENTATION OF SIGNIFICANT CHANGES

The proposed plan for OCVZ was released for public comment in March 1994. The proposed plan identified Alternative 2—Extraction/Treatment by VVE, as the preferred alternative. The agencies reviewed all written and verbal comments submitted during the public comment period. Upon review of these comments and preparation of the ROD, it was determined that no significant changes to the remedy would be required.

The source term for fate and transport modeling of contaminant migration in the vadose zone was based on estimates by Kudera (see reference on page 9) of the inventory of organic contaminants shipped from the Rocky Flats Plant in Colorado to the SDA between 1966 and 1970. Since the modeling and the risk assessment were conducted, estimates of the amount of organic wastes buried in the SDA have been revised for the development of the Contaminant Inventory Database for Risk Assessment (CIDRA). The CIDRA database is contained in *A Comprehensive Inventory of Radiological and Nonradiological Contaminants in Waste Buried in the Subsurface Disposal Area of the INEL RWMC During the Years 1952-1983*, EG&G Idaho, Inc., June 1994 (EGG-WM-10903). According to the CIDRA database, less $CCl_4$ and more TCE and TCA were disposed of in the SDA than originally estimated by Kudera. The revised estimates are not considered to warrant a significant change to the selected remedy because: (1) the model upon which the risk assessment is based was calibrated to VOC concentrations measured in the vadose zone in 1992; and (2) the selected remedy, VVE, will extract and treat all of the VOCs considered to be COCs, regardless of the relative concentrations of the organic contaminants in the vadose zone.